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VOL. CXLI.—No. 3675] LONDON: FRIDAY EVENING, JUNE 18, 1926 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 2nd July, 1926, for the SUPPLY and DELIVERY of TWO LOW-PRESSURE STEAM HEATING BOILERS to H.M. Stationery Office, Harrow, Middlesex. Drawings, specification, a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners of H.M. Works, &c.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 2646

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. MATERIALS for LIGHT RAILWAY TRACK.
2. BOILERS for STEAM LAUNCHES.
3. GRAIN HANDLING PLANT.

Tenders due on the 1st July, 1926, for No. 1, and on the 6th July, 1926, for Nos. 2 and 3.
Tender forms obtainable from the above. 2608

GREAT INDIAN PENINSULA RAILWAY ELECTRIFICATION.

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

(1) COAL and ASH-HANDLING PLANT for POWER STATION;
(2) STEEL-FRAME BUILDINGS for POWER STATION, including OVERHEAD ELECTRIC TRAVELLING CRANE;
(3) COMPLETE BOILER-HOUSE EQUIPMENT, also other PLANT and PIPING for POWER STATION.

Alternatively :—
COMPLETE BOILER-HOUSE INSTALLATION, including PULVERISED FUEL EQUIPMENT, with BUILDINGS, PIPING, and other PLANT for POWER STATION.
Tenders due on Friday, the 16th July, 1926, for No. 1; on Friday, the 30th July, 1926, for No. 2; and on Friday, the 6th August, 1926, for No. 3.
Specification and forms of Tender obtainable from the above at a fee of 5s. each for Nos. 1 and 2, and £2 for No. 3. Fees will not be returnable. 2699

Air Ministry. DIRECTORATE OF SCIENTIFIC RESEARCH.
TWO JUNIOR SCIENTIFIC OFFICERS REQUIRED at the Royal Aircraft Establishment. One primarily for work in physics, particularly on problems arising in connection with high-altitude flying, and one primarily for work in connection with aircraft indicating and recording instruments and similar apparatus. Candidates should have Honours Degree in Natural Science or Mechanical Science, and must be medically fit for flying and willing to fly as observer. Salary £175/15/£235 plus Civil Service bonus, giving a present total starting remuneration of £278 16s. per annum, with superannuation under the Federated Universities Superannuation System: Government contribution 10 per cent. of salary. Individual contribution 5 per cent. Preference given, other things being equal, to ex-Service men.—Application must be made on a form to be obtained from the SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it must be returned, quoting reference No. A. 167, not later than 10th July, 1926. 2647

Civil Engineer Required by the GOVERNMENT of SIERRA LEONE for the PUBLIC WORKS DEPARTMENT for two tours of from 12 to 18 months' service, with possible extension. Salary £800, rising to £720 a year by annual increments of £30. Outfit allowance of £60 on first appointment. Free passages and quarters and liberal leave on full salary. Candidates, aged 30 to 35, must have served articles with a corporate member of the Institution of Civil Engineers and have passed the examination qualifying for A.M.I.C.E., or hold equivalent professional qualifications. Must be good draughtsman, capable of designing and carrying out buildings, bridges, and other engineering structures and of taking out quantities and preparing detailed plans and estimates. Must be competent to execute surveys and to lay out and construct roads and have had experience as civil engineers on the construction of roads, buildings, and other public works.—Apply at once by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14275. 2663

Civil Engineer Required by the GOVERNMENT of NYASALAND for the PUBLIC WORKS DEPARTMENT. The selected candidate will be eligible for admission to the permanent and pensionable establishment after the completion of two tours of 20 to 30 months' continuous residential service or five years' satisfactory service on agreement. Salary £400, rising to £500 a year by annual increments of £20 and thence to £600 a year by annual increments of £25. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25-30, must be A.M.I.C.E. or hold equivalent professional qualifications and have had good experience on road survey and construction. Experience in the design and erection of steel and timber bridges and buildings is also necessary. Must be able to ride a motor bicycle. —Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/14335. 2664

Civil Engineers (2) Required by the RAILWAY DEPARTMENT of the TANGANYIKA TERRITORY for a tour of 20 to 30 months' service, with possible extension. Salary £400, rising to £800 a year, plus a temporary allowance of 20 per cent. at present authorised up to the 30th of June, when it will be subject to review. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 23 to 40, must be fully qualified railway engineers who have had good training and experience on recognised European, American or Colonial Railways. Candidates who are A.M.I.C.E. preferred.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14544. 2683

The Engineer

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PUBLIC NOTICES

Ministry of Transport. ROADS DEPARTMENT.
EASTERN DIVISION.
WANSFORD BY-PASS: GREAT NORTH ROAD.
HUNTINGDON AND SOKE OF PETERBOROUGH.

The Minister is prepared to receive TENDERS for the CONSTRUCTION of the WANSFORD BY-PASS and BRIDGE, in the counties of Huntingdon and the Soke of Peterborough.
Form of Tender, conditions of Tender, conditions of contract, bill of quantities and specification may be obtained from the Divisional Road Engineer, Roads Department, Eastern Division, Ministry of Transport, 6, Whitehall-gardens, S.W. 1, upon payment of a deposit of £10.
This amount will be returned to the tenderer if his Tender is a bona fide one, and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.
The drawings may be inspected at the Ministry, and copies of the specification, bill of quantities, &c., will be available on and after the 7th June, 1926.
Tenders on the official form, accompanied by a fully priced bill of quantities, and enclosed in a sealed envelope, endorsed "Tender for Wansford By-pass," must reach the undersigned by 10 a.m. on Wednesday, the 23rd June, 1926.
The Minister does not bind himself to accept the lowest or any Tender.
Dated this 2nd day of June, 1926.
('Signed) H. H. PIGGOTT,
Assistant Secretary.
Ministry of Transport. 2559

The High Commissioner for India is prepared to receive APPLICATIONS for NINE APPOINTMENTS as CIVIL ENGINEERS for temporary service on Indian State Railways.
Three years' agreement. Consolidated pay of Rs. 800-50-1000 per mensem for officers of non-Asiatic domicile and Rs. 600-50-800 per mensem for officers of Asiatic domicile. Initial pay according to age and qualifications.
Candidates must be British subjects and ordinarily not more than 35 years of age. They must have either (1) obtained a recognised University Degree or other distinction in Civil Engineering, or (2) be Chartered Civil Engineers, or (3) possess such other diploma or distinction in Civil Engineering as may be considered acceptable. In addition, they should possess at least three or four years' practical experience, preferably on railways or in railway works.
Information regarding the conditions of appointment and forms of application may be obtained from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 30th June, 1926. 2644

PUBLIC NOTICES

The High Commissioner for India is prepared to receive APPLICATIONS for TWO APPOINTMENTS as ELECTRICAL ENGINEER for service in the PUBLIC WORKS DEPARTMENT (Buildings and Roads Branch) of the GOVERNMENT of BURMA.
(a) For one post candidates must have had a thorough training in Electrical and Mechanical Engineering and should preferably hold a recognised degree or diploma. They should subsequent to training have had at least five years' practical experience in connection with modern engines, boilers, industrial combustion engines, electrical machinery, transmission lines and house wiring. A knowledge of refrigerating plant, pumping machinery and the law relating to electricity is also desirable. Age 30 to 35 years.
Engagement on agreement for three years on a fixed pay of Rs. 1250 per mensem, inclusive of overseas pay.
(b) For the second post candidates must have had the same training as stated above and, in addition, at least three years' practical experience. Age 25 to 28 years.
Engagement on agreement for three years. Pay in accordance with an age scale (e.g., age 25, Rs. 475 per mensem plus overseas pay Rs. 150 per mensem; age 28, Rs. 575 per mensem plus overseas pay £15 per mensem). Overseas pay is admissible only to an officer of non-Asiatic domicile.
The conditions applicable to both appointments will include a free first-class passage to Burma and return passage on satisfactory termination of agreement, admission to the benefits of a special Provident Fund, and certain allowances. Strict medical examination.
Forms of application and further particulars should be obtained from the SECRETARY to the HIGH COMMISSIONER for INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 2nd July, 1926. 2667

The Government of MADRAS REQUIRE an ASSISTANT EXECUTIVE ENGINEER for COCHIN HARBOUR WORKS.
QUALIFICATIONS.—Age 27-30 years; degree in engineering of a recognised University of Great Britain or Ireland; three or four years' training under a Chartered Civil Engineer of standing, with two or three years' further experience on public works, preferably harbour works; must be or become an Associate Member of the Institution of Civil Engineers.
Five years' agreement. Pay at the rate of Rs. 750-50-950 per mensem. Initial pay according to qualifications and experience. Free passage to India and return on satisfactory termination of agreement. Provident Fund. Strict medical examination.
Forms of application and further particulars should be obtained from the SECRETARY to the HIGH COMMISSIONER for INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 30th June, 1926. 2666

PUBLIC NOTICES

Civil Engineer Required by the GOVERNMENT of the GOLD COAST for the Cape Coast Water Supply for two tours of 12 to 18 months' service, with possible extension. Salary £480, rising to £720 a year. Free quarters and passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, aged 25 to 35, should be fully trained Civil Engineers, preferably A.M.I.C.E., who have had experience in waterworks construction and pipe laying.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14645. 2682

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.,
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors. Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 2240

Portsmouth Municipal College.
MECHANICAL AND CIVIL ENGINEERING DEPARTMENT.
Principal:
OLIVER FREEMAN, Wh.Sc., A.R.C.S., B.Sc.
Head of Department:
R. C. PRESCOTT, M.Sc. (Tech.), A.M.S.T., M.I. Mech. E.
APPLICATIONS are INVITED for the APPOINTMENT of a LECTURER in MECHANICAL ENGINEERING. Salary according to the Revised Burnham Scale. Further particulars and forms of application may be obtained from the undersigned, to whom applications should be returned not later than June 30th, accompanied by copies only of not more than three recent testimonials.
H. E. CURTIS,
Secretary.
Offices for Higher Education,
The Municipal College, Portsmouth,
N. 15.6.26. 2673

Robert Gordon's College, ABERDEEN.
The Governors invite APPLICATIONS for the POSTS of :—
1. HEAD of the MECHANICAL ENGINEERING DEPARTMENT.
2. HEAD of the ELECTRICAL ENGINEERING DEPARTMENT.

Candidates must be University graduates in Engineering and have had thorough practical training and experience of instruction in their respective branches of Engineering. Salary £600.
The Engineering Department of the College co-operates with the University of Aberdeen in providing Degree Courses in Engineering.
A statement of the duties attaching to the appointments may be had from the undersigned, with whom 16 copies of letter of application and of testimonials should be lodged not later than 12th July, 1926.
JAMES McKENZIE,
2651 Secretary and Registrar.

Batley Corporation Waterworks. AQUEDUCT FROM BROWNHILL TO STAINCLIFFE.—CONTRACT A.
(SECTION FROM BROWNHILL TO COOPER BRIDGE).

The Waterworks Committee invite TENDERS for the LAYING and JOINTING of a PIPE LINE between the Brownhill Reservoir, now in course of construction near Holmbridge, and a point on the Cooper Bridge Road near Cooper Bridge Station, on the London, Midland and Scottish Railway.
The work consists of the excavation of trenches and the laying and jointing therein of about 18 miles of Cast Iron Pipes, 18in. in diameter, together with the fixing of Valves and Ironwork in connection therewith, and the construction of the Valve Wells and the Abutments of Bridges for carrying the pipes across rivers and railways.
Plans and drawings may be seen, and specification and forms of Tender obtained, on application to Messrs. G. H. Hill and Sons (Manchester), Civil Engineers, 40, Kennedy-street, Manchester, upon deposit of a cheque for Three Guineas.
This sum will be returned to the tenderer, provided that he shall have sent in a bona fide Tender and shall have not withdrawn the same, and shall have returned the documents lent to him.
Sealed Tenders, endorsed "Batley Aqueduct, Contract A: Tender for Laying, &c., Cast Iron Pipes," and addressed to the "Chairman of the Waterworks Committee," must be forwarded to the Town Clerk, Town Hall, Batley, on or before the 14th day of July, 1926.
The Committee do not bind themselves to accept the lowest or any Tender.
THOS. E. CRAIK,
Town Clerk.
Town Hall, Batley.
16th June, 1926. 2693

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PUBLIC NOTICES

B. B. & C.I. Railway.

The Directors are prepared to receive up to Noon on Tuesday, 6th July, TENDERS for the SUPPLY of :—

1. STEEL BOILER TUBES, FLUE TUBES and STEAM PIPES.
2. WHEELS and AXLES for CARRIAGES and WAGONS.
3. LAMINATED and ELLIPTICAL SPRINGS.
4. HELICAL and VOLUTE SPRINGS.

And up to 2.30 p.m. on Tuesday, 6th July, TENDERS for the SUPPLY of :—

5. COPPER FIRE-BOX PLATES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for Nos. 1, 3, and 5, and 10s. each for Nos. 2 and 4 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, S.W. 1,
14th June, 1926. 2658

Surrey County Council.

HIGHWAYS AND BRIDGES DEPARTMENT.

The Surrey County Council invite TENDERS for the WORKS to be carried out in the CONSTRUCTION of the following FERRO-CONCRETE BRIDGES over the Southern Railway, together with certain Accessory Works in connection therewith :—

Bridge No. 1 is over the Guildford Branch Railway, in the Parish of Thames Ditton.

Bridge No. 2 is over the Main Line, in the Parish of Merton.

Bridge No. 3 is over West Barnes-lane and the Epsom Branch Line, in the Parish of Merton.

Copies of the form of Tender, instruction to persons desirous of tendering, and bill of quantities may be obtained from the undersigned, and the form of contract, general conditions, specification and drawings may be examined at the office of the County Surveyor on weekdays (except Saturdays) from 10 a.m. to 4.30 p.m. on and after Tuesday, the 15th instant, on payment of a deposit of Ten Guineas, which will be refunded upon receipt of the above-mentioned documents complete with a bona fide Tender, and each Tender must be submitted, enclosed in a sealed envelope, endorsed "Tender for Bridge at ——," and lodged not later than 9 a.m., 28th June, 1926.

The Council does not bind itself to accept the lowest or any Tender.

W. P. ROBINSON, Assoc. M. Inst. C.E.,
County Surveyor.

County Hall Annexe,
Kingston-on-Thames.
9th June, 1926. 2626

Bombay, Baroda and Central INDIA RAILWAY.

CHIEF DRAUGHTSMAN FOR LOCOMOTIVE AND CARRIAGE DEPARTMENT.

REQUIRED, for service in India, a CHIEF DRAUGHTSMAN, between 25 and 35 years of age, capable of dealing with Locomotive, Carriage and Wagon Drawing-office Work, who must have served an apprenticeship with a Railway Company or large Locomotive Engine Builders, and subsequently have had experience in any up-to-date well-managed drawing-office. A general knowledge of works, design and arrangement of machinery is desirable.

Candidates must possess a good technical knowledge, and must have undertaken a thorough course of instruction at an Engineering College or large Technical School, and must be capable of correctly calculating stresses in boilers, working parts of engines and machines, and in simple structural designs and girders. The selected candidate will also have to deal with the usual calculations of a locomotive drawing-office regarding inactive power, &c. &c. Other things being equal, preference will be given to applicants who have been required to see work during manufacture.

TERMS.—A three years' agreement in the first instance, and service may be continued if satisfactory. Free second-class passage to India and return on satisfactory termination of services.

SALARY.—Rupees 500 per calendar month.

The selected candidate will be required to pass a strict medical examination before appointment.

Applications (by letter only), giving full particulars of general and technical education and honours gained (if any), age, whether married or single, and details of experience in chronological order, with dates, together with COPIES ONLY of testimonials, must be addressed to the undersigned not later than 2nd July, 1926.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
15th June, 1926. 2684

Madras and Southern Mahratta RAILWAY.

2 TEMPORARY ASSISTANT CIVIL ENGINEERS.

REQUIRED for service on the Company's Railway in India, TWO ASSISTANT CIVIL ENGINEERS, 24 to 27 years of age, and preferably unmarried, who must be Associate Members of the Institution of Civil Engineers or possess the degree in civil engineering of a recognised Engineering College or University.

Candidates must have had some experience of outdoor work with a railway company or public works contractor.

TERMS.—A first-class free passage to India and return on satisfactory termination of services, and a three years' agreement, which may be continued if agreeable to both parties.

SALARY.—Rupees 525 to 675 per calendar month, according to age and experience.

The selected candidates will be required to pass a strict medical examination before appointment.

Applications (by letter only), giving full particulars of general and technical education, honours gained (if any), age, whether unmarried, and details of practical experience, in chronological order (with dates) together with COPIES ONLY of testimonials, must be addressed to the undersigned not later than 2nd July, 1926.

THE SECRETARY,
Madras and Southern Mahratta Railway Co., Ltd.
25, Buckingham Palace-road,
Westminster, London, S.W. 1.
15th June, 1926. 2680

Napier Harbour Board (New ZEALAND).

RESIDENT ENGINEERSHIP.

APPLICATIONS are INVITED for the above POSITION.

Salary £1250 per annum.

Canvassing members of the Napier Harbour Board will disqualify applicants.

Applications to be addressed to the SECRETARY of the NAPIER HARBOUR BOARD and delivered at the Harbour Board Office, Napier, New Zealand, not later than Monday, October 11th, 1926.

A copy of the conditions can be obtained from the Board's London Agents, Messrs. W. and A. McArthur, Ltd., 18/19, Silk-street, Cripplegate, London, E.C. 2. 2415

Western Australia.—Applications

are INVITED by the Agent-General for Western Australia for THREE STRUCTURAL ENGINEERING DESIGNING DRAUGHTSMEN for the War and Works Branch of the Western Australian Government Railways.

Salary, Class 2, range £804 to £424 per annum.

Applicants must be thoroughly versed in the details of timber, steel and masonry construction, including reinforced concrete.

Transport allowances : single man, £75 ; married man, £150 ; married man with family, £200. Salary to commence from the date of taking up duty in Western Australia. Should the successful applicants voluntarily relinquish their respective positions before the expiration of two years from the date of appointment they will be called upon to refund the amount of transport allowance.

Applicants must state age and whether married or single. Applicants should not be over 40 years of age.

Applications, accompanied by testimonials or references, must reach the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, 115-116, Strand, London, W.C. 2, not later than 12th July, 1926. 2665

PUBLIC NOTICES

Sudan Government, Irrigation Department,

REQUIRE the SERVICES of an ASSISTANT ENGINEER (Projects) for field work, survey, and construction. Age 26 to 32, single preferred. Candidates should possess A.M.I.C.E. degree or equivalent. : Salary £E.500 to £E.600 per annum according to age and qualifications. Two years' contract. Strict medical examination. Free first-class passage.—Apply by letter to ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "Asst. Engineer." 2689

Sudan Government Railways

REQUIRE the SERVICES of a DISTRICT ENGINEER. Age 26 to 32, single. Candidates should have had practical training on a British railway and possess an A.M.I.C.E. degree or equivalent. Starting rate of pay £E.480 to £E.540 per annum, according to age and qualifications (£E.1 equals £1 0s. 6d.). Progressive and pensionable post if retained. Strict medical examination. Free first-class passage. Liberal leave on full pay with assisted passages.—Apply by letter to ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "District Engineer." 2671

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS UNLESS SPECIFICALLY REQUESTED.

WANTED, an ENGINEER SALESMAN, to Deal with Rotary Pumps. Slight knowledge of refrigeration would be an advantage, although not essential. Applicants should be well up in Pumping. Progressive berth to sales managership.—Address, 2677, The Engineer Office. 2677 A

WANTED by a Large Firm of Structural Engineers (European) in India, a fully qualified ENGINEER. Good commercial knowledge and experience in negotiating contracts essential, also drawing-office and field experience. Public school man, aged 30-38, preferred.—Address, giving full particulars of training, experience, age, &c., 2612, The Engineer Office. 2612 A

WANTED, WORKS MANAGER for Small Works manufacturing Producer Gas Plants and Engineering Specialities. Boilermaker with engineering experience preferred. Must be capable of estimating labour costs and familiar with latest practice. State full particulars of experience and salary required.—Address, 2669, The Engineer Office. 2669 A

ASSISTANT POWER STATION ENGINEER for Brazil. Capable taking full charge. Thoroughly experienced in running and maintenance of Steam Turbines, Traction and Lighting Plant, and Overhead Distribution System. Knowledge of Portuguese desirable. Free passage out and home. Three years' agreement. State fully experience, age, and salary expected.—Box 57, c/o Judd's, 47, Gresham-street, E.C. 2. 2652 A

ASSISTANT REQUIRED in Water Engineer's Office for Waterworks on South Coast of England ; must be good Surveyor, Leveller and Draughtsman, possessing technical knowledge, and have had experience in Pumping Station and Distribution Departments. Knowledge of Building Construction desirable ; age about 25.—Write, with full particulars, salary required, and when disengaged, to Z. E. W. C., c.o. Deacon's, Leadenhall-street. 2505 A

CONSTRUCTIONAL ENGRS., London, REQUIRE ASSIST. : Building Supervision essential. Good scope to keen worker.—Address full exp., wages. P2025, The Engineer Office. P2025 A

ENGINEER.—WANTED IMMEDIATELY, Experienced CONSTRUCTIONAL ENGINEER, Steel and Concrete, to Act as Superintendent during construction of large cold store, Germany. State experience, knowledge of German language, and salary required.—Address, P2018, The Engineer Office. P2018 A

ESTIMATOR REQD., Thoroughly Exprd. in Mass production methods on small engineering and instrument work. Man with planning exp. preferred.—Address, stating full particulars, salary reqd., 2542, The Engineer Office. 2542 A

FIRST-CLASS ENGINEER, to Take Over the Maintenance of Plant and the Production on modern lines of a Foundry and Works manufacturing a large range of articles for domestic and engineering purposes. State experience and salary required.—Address, P2007, The Engineer Office. P2007 A

LOCOMOTIVE SUPERINTENDENT REQD. for S. America. Good exp. same work ess., also fluent Spanish. Good prospects. Aged 28/35, married or single, outrs.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. 2679 A

REFRIGERATING ENGINEER SALESMAN WANTED. Progressive position to capable man.—State age, experience, salary to "E.A.," Pulsometer Engineering Co., Ltd., Reading. 2648 A

REQUIRED for Service in the Tropics, SINGLE MAN as CRANE or STEAM SHOVEL OPERATOR. Salary 225 dollars U.S. cy. per month, outfit allowance and passage paid.—Apply by letter, stating age and full particulars, to "Z.F. 132," c/o Deacon's, Fenchurch-avenue, London, E.C. 3. 2661 A

REQUIRED, ASSISTANT ENGINEER for Dockyard in India, single, age about 26 ; must have served time in Marine Engineering Workshop and have Drawing-office experience. Three years' agreement ; salary Rs. 475 to Rs. 500 per month. Free quarters provided. Only applicants with good credentials and first-class references will be considered.—Write, Z. K. B., care Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 2660 A

WANTED by London Firm of Constructional Engineers, smart young DRAUGHTSMAN : experience on Constructional Work essential. State experience, salary, and age.—Address, 2686, The Engineer Office. 2686 A

WANTED for Lancashire District, DRAUGHTSMAN, thoroughly acquainted with the design of Mechanical Parts of Electric Winders.—Address, stating age, details of experience, and some of the largest equipments dealt with, also salary required. 2695, The Engineer Office. 2695 A

WANTED for the North Midlands, a Good MECHANICAL DRAUGHTSMAN, with experience in Cement and Crushing Machinery.—Address, stating age, experience, salary required, and when at liberty. 2696, The Engineer Office. 2696 A

CAPABLE DRAUGHTSMAN, Between 30 and 35, with works experience and theoretical training, WANTED for Mechanical Engineers in London. State age, experience, and salary required.—Address, 2691, The Engineer Office. 2691 A

DRAUGHTSMAN, General Engineering, First-class, preference will be given man with mining and metallurgical experience.—Apply, stating age, experience, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 2657 A

DRAUGHTSMAN, MECHANICAL, WANTED. Experience with Baling Presses an advantage, but not essential.—Address, stating experience, age, salary wanted, and when available, 2655, The Engineer Office. 2655 A

DRAUGHTSMAN REQUIRED, with Experience in the general lay-out and arrangements of Commercial and Passenger Chassis, also Body Work. A knowledge of chassis details is desirable.—Apply, giving age, experience, and salary expected, to DENNIS BROS., Ltd., Guildford. 2637 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN WANTED, with Practical Shop experience, for detailing drawings of Steam Piping, Boilers, Gas Producer Details, Structures, &c. State age, salary, and experience.—Address, 2654, The Engineer Office. 2654 A

ENGINEER DRAUGHTSMAN REQUIRED, Take Full Charge Drawing-office in India. Must have had good theoretical knowledge and practical experience in all classes of Steel Structure Work. Age about 30, single preferred. Salary £800/£1000.—Call C. W. PETTY and COMPANY (Appointment Specialists), 58, Haymarket, S.W. 1. 'Phone, Gerrard 5412-3. P2005 A

HEAD DRAUGHTSMAN REQUIRED for India, for General Engineering Works ; must have had good theoretical and practical training in Structural Work ; must be capable of taking charge of drawing-office and designing bridges, tanks, roofs, and all classes of steel structures ; aged about 30, single preferred.—Application, stating age and giving full particulars of training and experience, with copies of recent testimonials, to be sent to Z. O. 990, c/o Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 2594 A

HEATING DRAUGHTSMAN REQUIRED ; Must be fully experienced, capable of scheming and estimating for large contracts.—State age, experience, and salary required to the BRIGHTSIDE FOUNDRY and ENGINEERING CO., Ltd., 17, Summer-row, Birmingham. 2674 A

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KEEN COMPETITIVE DESIGNERS for Constructional Engineers, Manchester district. State fully experience and when at liberty.—Address, 2697, The Engineer Office. 2697 A

REQUIRED, a JUNIOR DRAUGHTSMAN, with knowledge of Wrought Iron Tubes and Fittings.—Apply, stating age, experience, and wages required, to P.O. Box 24, Walsall. 2692 A

REQUIRED by Large and Old-established Firm of Constructional Engineers in India, STRUCTURAL DRAUGHTSMAN, also STRUCTURAL FOREMAN ; age not over 33 and must be single.—Reply, giving fullest details of education and experience, to "Z.A. 142," c/o Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 2681 A

SENIOR DRAUGHTSMAN REQUIRED, Thoroughly experienced in design of modern Steam Road Rollers. State age, experience, and salary required.—Address, 2015, The Engineer Office. 2015 A

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COACHING by CORRESPONDENCE or PERSONALLY in office for Civil Engineering Examinations.—Particulars and terms from S. W. HOWARD, 54, Cavendish-avenue, New Malden, Surrey. P1905 E

COACHING for INST. C.E. EXAMINATION. Personal or by correspondence.—To G. W. M. BOYCOTT, Assoc. M. Inst. C.E., Chandos House, Palmer-street, Westminster, S.W. 1. 2477 E

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LEARN SURVEYING and LEVELLING.—Thorough practical instruction by expert.—E. MOUL (late L.S.W. and S.P.D. Rly.), Hollybank, Woking. P1749 E

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AN ENGINEER, an OFFICE, and a CAR in Manchester area are waiting to REPRESENT sound FIRM in above area. What firm requires their services ?—Address, P1971, The Engineer Office. P1971 D

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Late Lord Stevenson.

ALTHOUGH Lord Stevenson was not an engineer, it is fitting that his death, on Thursday of last week, June 10th, should be recorded in our columns, for in many directions the work which he undertook in the last ten or eleven years of his life brought him into contact with, or reacted upon, the engineering industry. He was born at Kilmarnock, Scotland, in 1873, and eventually rose to be managing director of a whiskey distilling firm. When war broke out in 1914 he offered his services gratuitously to the Government in any capacity in which they could be usefully employed. He was not left long in idleness. Under the Ministry of Munitions he was from 1915 to 1917 Director of Area Organisation, and subsequently vice-chairman of the Ministry of Munitions Advisory Committee, a member of the Central Reconstruction Committee, and a member of the Munitions Council for Ordnance. After the war he was appointed chairman of the Committee on Demobilisation and Reconstruction, and from 1919 to 1921 served as Surveyor-General of Supply to the War Office, as a member of the Army Council and the Air Council, and as vice-chairman of the Advisory Committee on Civil Aviation. In 1921 he became personal adviser on commercial affairs to the Secretary for the Colonies, and in that capacity acted as chairman of the Rubber Investigation Industry, which produced the celebrated plan for the restriction of rubber output, a plan which is commonly held to have saved many plantations in the East from ruin. His most conspicuous work was still to do. As chairman of the Standing Committee of the British Empire Exhibition, his forceful personality led more than any other factor to the opening of that great undertaking on the day appointed in spite of difficulties which at one time seemed insurmountable. In a tribute to his memory, Mr. Winston Churchill has remarked that during his ten years of public service for honour alone Lord Stevenson wore out the whole of his exceptional strength of mind and body, and exhausted in the service of the State the vital forces by which an easier and less disinterested career might have been carried to a long old age.

Naval Limitation Deferred.

THE proceedings at the Geneva preparatory Conference on Armaments have not as yet resulted in any definite formula for the restriction of combatant forces by sea, land, or air, nor does it appear likely that any such formula will emerge from the present discussions. A Japanese proposal that the British Empire, the United States and Japan should agree to a further graduated reduction of their respective fleets without reference to France or Italy—the other two parties to the Washington Treaty—has been declined by the American Government, on the ground that naval retrenchment, to be effectual, must be universal and simultaneous. In effect, therefore, a deadlock seems to have been reached with regard to the question of limiting naval armaments. There is, consequently, every prospect that the naval construction now in hand or projected will be duly carried out. The Japanese Ministry of Marine has this month revived the building programme which was deferred last year for pecuniary reasons. If the consent of the Diet is obtained, contracts will be awarded for thirty-three new vessels. They comprise four cruisers of the 10,000-ton class, sixteen destroyers of 1700 tons, five submarines of 2000 tons, five gunboats of 400 tons, one minelayer, and two fleet auxiliaries. Two of the cruisers are to be laid down in 1927 and two in 1928. In the first design for the new destroyers an armament of 6in. guns was provided for, but it has since been decided to substitute 4·7in. guns for the heavier weapons, at a saving of £200,000. The last of the vessels is to be completed in 1931.

The A.E.U. and Unskilled Workers.

UP to the present the Amalgamated Engineering Union has taken pride in maintaining its position as a union of craftsmen. If, however, a change of policy now being advocated by the Union's National Committee becomes effective, all male workers over the age of sixteen employed in the engineering industry will become eligible for membership, with the result that unskilled and semi-skilled men will come within the scope of the organisation. It cannot be denied that internal developments in the industry are in keeping with this change of policy, for as machinery and workshop methods progress, the skilled worker finds himself less and less able to maintain his position against the advance of the semi-skilled and unskilled. The effect of the past policy of the Union in excluding all but craftsmen from its ranks is seen in the amazing number of different unions having an interest in the engineering industry. Whether the change will react in favour of peace and harmony or the reverse has yet to be seen, but in so far as it should tend to remove difficulties caused in the past by the alleged encroachment of unskilled and semi-skilled workers on the rights claimed by the skilled workers, it will no doubt prove beneficial. It would appear, however, that the policy involves the establishment of two sections within the union, one open only to the craftsmen and enjoying the friendly society benefits, hitherto granted to the skilled members, and the other a purely industrial section enjoying fewer benefits and open on a reduced scale of contributions to all classes, skilled or otherwise. The Executive Council of the Union does not seemingly wholly approve of the establishment of two distinct sections with two separate policies, and while seeking to devise means for protecting the interests of its existing skilled membership, is anxious that the question of unification of the two sections should be immediately faced and resolved.

Electricity Supply During the General Strike.

A CASE of considerable interest to engineers and electricity supply undertakings was heard on Thursday of last week, June 10th, before the Petty Sessional Justices at St. George's-in-the-East, London. At the instance of the Stepney Borough Council, Messrs. Buck and Hickman, the well-known Whitechapel firm of engineers and merchants, were summoned for the non-payment of a portion of the general district rate for the current financial half-year. The sum involved exceeded £550. Counsel for the firm stated that it had never previously refused to meet its due obligations in the matter of rates, and it desired that the reasons why it now refused to pay should be stated. The firm contended that by criminal conspiracy to control the supply of electricity for a political purpose the Borough Council had unlawfully deprived it of electricity supply from May 3rd to May 12th. Under the Electric Lighting Confirmation Order, it was argued, the Council was liable to penalties for failure to supply except when such failure was caused by accident or *force majeure*. Counsel for the firm claimed that there had been no *force majeure*, because the Electricity Commissioners had announced that they were prepared to supply volunteer labour to carry on undertakings affected by the general strike. The Stepney Council did not take advantage of this offer, with the result that the firm was deprived of power and sixty-five men were thrown out of work. The chairman of the Petty Sessions, while sympathising with the firm, said that the rates must be paid. They could, he stated, be paid under protest, and thereafter the firm might take any action it pleased.

New Canadian Pacific Vessels.

WITH the recent arrival in England of Mr. E. W. Beatty, the President of the Canadian Pacific Railway Company, an early decision may be expected regarding the placing of the orders for seven new ships—two liners and five cargo vessels—which are to be added to the fleet of Canadian Pacific Steamships, Ltd. The liners will be of the "Montcalm" class, with a length of 600ft., and a probable gross tonnage of 17,500. The propelling machinery will, we hear, be of particular interest. High-pressure steam turbines, with single-reduction gearing, are to be employed, and steam will be supplied from a combined oil-fired Yarrow water-tube and Scotch boiler installation at a pressure of 350 lb. per square inch. The boiler plant will be so arranged, we learn, that the Yarrow boilers will deliver steam direct to the turbines, and will receive all the return condensate as feed water with a certain amount of make-up feed from the Scotch boilers, which themselves will be furnished with the usual feed arrangements. By this means it will be difficult for any impure water to reach the water-tube boilers. A similar arrangement for 250 lb. pressure is to be adopted for certain of the cargo vessels, others of which may be motor ships. For the steam turbine-driven cargo ships mechanical stokers are specified, and it is probable that the machinery installations will, when the orders are placed, be found to be of more than usual interest. Another liner of the Canadian Pacific fleet, the Empress of Australia, which is fitted with steam turbines and Föttinger hydraulic transformer gear, and which was described in our issue of July 7th, 1922, is to be re-engined with Fairfield steam turbine machinery designed for an output of 18 knots.

Co-partnership in the Electrical Engineering Industry.

IN his address to the shareholders of the Brush Electrical Engineering Company, Ltd., at the annual meeting held on Monday, the chairman, Mr. E. Garcke, gave an outspoken review of the general conditions of industry in this country to-day as he saw them. After the war, he said, there came a false dawn. Those who made the greatest mistake in the matter were the hard-headed so-called practical men of business, who refused to take the trouble to understand the theories on which their practice rested, who persisted in regarding labour as a commodity to be bought in the cheapest market and sold in the dearest, who held that the first thing to do was to reduce wages. To-day the trade unions were organised to fight capital and the employers' associations to fight Labour. While that condition prevailed there could be no real peace in industry. To remove this deplorable state it was essential to promote a spirit of united interest and purpose. While the worker desired a fair reward for his labour, security of employment, and a higher status, the employer wanted the removal of restrictions on output, so that he might make a fuller use of toil-reducing machinery and a more efficient use of fuel energy. These ideals were not opposed to each other, and if they were pursued together, both sides would gain their objects in a large measure. The company's tentative scheme of co-partnership had been devised on the basic principle that the surplus remaining over after the rights and obligations of the company and the various parties interested in it had been satisfied should be distributed among all who had contributed to its production. The directors had avoided making the mistake of presenting a cut-and-dried scheme, and had decided that the best way to proceed was to meet the trade unions, the federation of employers and representatives of the workers and staff, to discuss and collaborate on the details. There was evidence, Mr. Garcke concluded, that all concerned would respond whole-heartedly to make the scheme a success. A provisional Co-partnership Council would be established to draw up a definitive scheme, which would at a later date be submitted to the shareholders for their approval.

The Shipbuilding Outlook.

SOME interesting comments on the shipbuilding industry, which were tempered by a vein of optimism, were made by Sir Alexander M. Kennedy, the chairman and managing director of the Fairfield Shipbuilding and Engineering Company, Ltd., on the occasion of the launch of the Bibby motor liner Shropshire from the firm's Govan yard last week. Sir Alexander said that it was not perhaps sufficiently realised what an important part atmosphere played in lifting the industry out of the gloom of a severe depression. He believed that the atmosphere in the industry was better now than it had been for the past six years. The fact had, however, to be faced, that there could be no recovery until British costs were brought into closer relation with world prices. The failure of the general strike might, he thought, be used by the trades unions as a turning point for getting back to industrial reality, while all who were engaged in industry could, by addressing themselves to hard effort and sincere co-operation, create an atmosphere which would give the country a fresh start. In the shipbuilding industry firms were being prevented from reaping the results of the economies and sacrifices they had made by the unduly high prices which they had still to pay for outside services and materials. All British industry was interdependent, and he believed that the need for giving the export industries a chance was at last being appreciated. Given a period of peace and stability, of pulling together, within the heavy industries, and of relief from the burdens that sheltered occupations and services imposed upon the industry, he thought that confidence could very quickly be restored to the point of a revival in trade. The Government might help industry by concentrating upon all economies which would tend to reduce the cost of living from its present 60 to 70 per cent. above the pre-war standard. The new Bibby liner is a 500ft. vessel built for general cargo and passenger service to India and Burma. She will be propelled by twin Fairfield-Sulzer eight-cylinder marine oil engines, designed for a total output of 7700 brake horse-power at a speed of about 110 revolutions per minute.

The Coal Stoppage.

WHILE here and there a few mines have restarted, either with non-union labour or with the aid of union members who have become tired of the idleness imposed upon them by their leaders, it would be incorrect to say that the past week has witnessed the beginning of a movement among the miners that will lead to a general resumption of work in defiance of orders. The situation may develop in that direction, but for the present it would be unwise to place any reliance upon its doing so. Of much more importance as a factor bearing on the dispute was the Prime Minister's statement in the House of Commons on Tuesday when he indicated the lines on which the Government proposed to proceed by way of legislation designed to end the stoppage. Mr. Baldwin intimated that the Government intended to retain the Seven Hours Act, but to introduce legislation enabling an extra hour to be worked for a period of time. He also stated that it was intended to legislate this session to give effect to certain of the recommendations of the Coal Commission which would be likely to have an immediate effect on the industry. The recommendations to be covered by the proposed legislation deal with such matters as the amalgamation and absorption of mines, the provision of pit-head baths, and the recruitment of miners. In the course of his remarks, Mr. Baldwin gave the House certain figures which he had received from the coal-owners, showing the financial effect of a temporary return to the eight hours day. In certain districts, producing about half the total output of the country, the return to the eight-hour day would, according to the owners, enable them to pay the existing wages throughout July, August and September. In more than half the remainder of the districts, the reduction, if any, would be less than 10 per cent. The Government, Mr. Baldwin stated, had come to the conclusion that a longer working day was a necessity.

"Spread" of Metal in Rolling.

By C. E. DAVIES, A.M.I. Mech. E., M. Inst. Met.

No. II.*

REVERTING to the chief purpose of these articles, viz., the determination of spread in cold rolling round, square and comparatively narrow rectangular sections, the data given in the tables may be of some help in estimating the probable spread which will result in any given rolling operation, and show clearly the difference in spreading with the three different sections considered.

Ratios are given connecting per cent. spread and per cent. reduction, but the use of these for the purpose of calculating spread is not very convenient in practice, and generally the method of calculation can be expressed as follows :—

Given a section of width W and thickness T to be reduced to T_2 in one or more passes. Required to find the resulting final width W_2.

The per cent. reduction—

$$r = \frac{T_1 - T_2}{T_1} \times 100 ;$$

and from curves or tables the approximate value of the per cent. spread S or ratio $s/r = x$ can be found.

From this data we have—

$$S = x\,r = \frac{W_2 - W_1}{W_1} \times 100$$

$$= x\,\frac{T_1 - T_2}{T_1} \times 100 = \frac{W_2 - W_1}{W_1} \times 100$$

$$\therefore W_2 = W_1\,x\,\frac{(T_1 - T_2)}{T_1} + W_1 \quad . \quad . \quad . \quad . \quad . \quad (A)$$

$$\text{or } W_2 = \left(W_1\,x\,\frac{r}{100} \right) + W_1$$

$$= W_1 \left(x\,\frac{r}{100} + 1 \right) \quad . \quad . \quad . \quad . \quad . \quad (B)$$

The difficulty in the way of obtaining an accurate estimate in this way is that the deciding factor x must be correct, not only for the particular reduction, but also for the shape and proportions of the section, and the number of passes taken in obtaining the desired reduction must be approximately the same as that in the test from which the value of x was determined.

The trouble is, of course, due to the fact that there appears to be no simple law connecting the per cent. spread with per cent. reduction for any particular section, and, it was in the endeavour to find some more constant relation which would determine the amount of spread when effecting a given reduction in thickness, that the writer turned his attention to the alteration in the perimeter of the section. Referring back to the tables of test results, the perimeters of section before and after reduction have been noted, also the ratio which the perimeter P_1 before rolling bears to that after the pass P_2.

This ratio K is also tabulated, and investigation on these lines proved to be most interesting in so much that the value of K over a wide range of reduction is seen to approach a constant.

In the cases of reduction from round to flat, taking the figures in Table I. *ante*, over the series of independent reductions, from 7 to 62 per cent. reduction in thickness, K varies from 1·16 to 1·37. These values are plotted by curve in Fig. 12, and it will be noted if the figure for K on the first line of Table I.—Test No. 6—is omitted, that K is very nearly a constant over a range of reduction from 19 per cent. to about 50 per cent., all being very near the average value of 1·19; after 50 per cent. reduction the perimeter increases more rapidly, the average from 49 per cent. to 62 per cent. being about 1·3.

Consequently, allowing for errors of experiment, it is fairly correct to conclude that in flattening from round to flat up to about 50 per cent. reduction, the perimeter of the section is increased by about 19 per cent., and after 50 per cent. there is a comparatively sudden change and the increase is about 30 per cent.

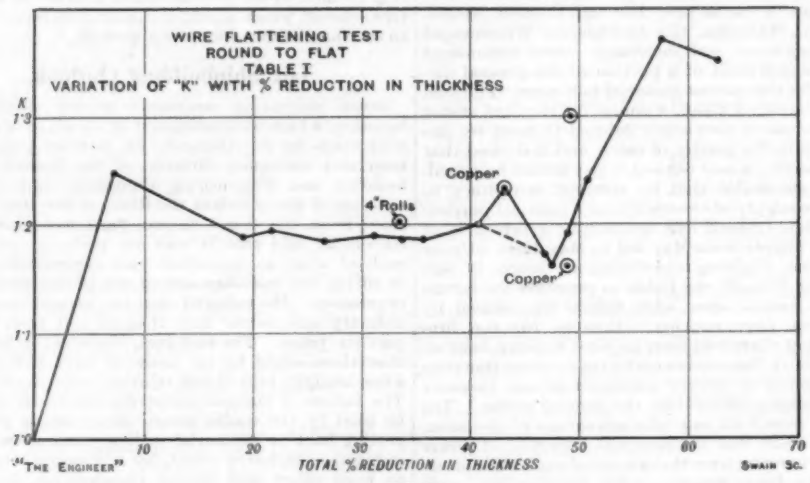


FIG. 12

Turning to the second series of tests in Table II., as there are successive reductions it is necessary to tabulate two constants which have been distinguished as K and *k*, the former being the ratio of the perimeter after the particular pass to that of the original section at start, and the latter being the relation between the perimeter before and after each separate pass. The average value of K for the whole range is slightly greater than that obtained from tests recorded in Table I., being about 1·20, but this increase is mainly due to the inclusion of the figure for the first reduction, 1·25—which was omitted in taking the average in the previous case. Moreover, it is interesting to note that the value of K decreases fairly steadily for the succeeding passes. This decrease is explained by referring to the values for the other coefficient *k*, which, after the first pass, is also nearly constant, ranging from ·975 to 1·01, average about ·99; again allowing for small errors in measurements, the perimeter is seen to be practically unaltered by continued reductions after the first pass from round section; actually there is a reduction in perimeter of about 1 per cent. after each pass. See curve, Fig. 13.

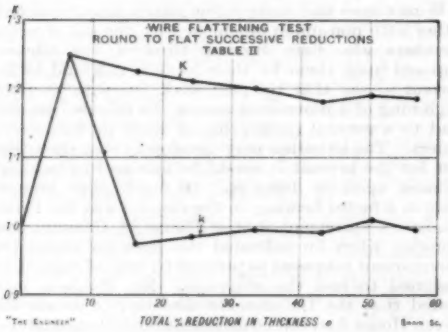


FIG. 13

In the case of square sections, independent tests, as Table III., K is only slightly reduced by the rolling, average value ·90. It is most noticeable that when rolling from square there is no increase in perimeter, even after the first pass, which is so characteristic of reduction from the round, but an average reduction of about 10 per cent. These values for K are plotted in curve—Fig. 14. On examining the figures for the successive reductions on square section—Table IV.—while the first pass results in a reduction in perimeter of about 5 per cent., this reduction increases with the succeeding passes, and taking the complete range up to 87 per cent. reduction the average for K is ·950.

It is also remarkable that the perimeter decreases steadily with reductions up to about 50 per cent., after which there is an equally steady increase, until at 87 per cent. reduction the original P_0 is exceeded—by 5 per cent.

The values of *k* for each pass emphasise this, there being a reduction in perimeter for the first four passes, the amount of this reduction decreasing until at about 50 per cent. *k* is unity, after which further reductions make practically no change in the perimeter during reductions from 50 per cent. to 65 per cent., and from then up to the maximum reduction recorded increases at about 5 per cent. result. Curves illustrating these conclusions are given in Fig. 15.

The similar tests given in Table V., although referring to a different metal agree so closely in regard to the factors K and *k* that no special comments are necessary.

As might be expected in the tests on rectangular sections—Table VI.—the changes in perimeter follow exactly similar lines to those remarked in connection with square section. The first pass causing a reduction—about 2½ per cent.—following with a steady but slow decrease until a reduction of about 60 per cent. is reached, and an equally steady increase from this up to 88 per cent. reduction; corresponding to this the values of *k* for each pass first show a decrease, the rate of which itself decreases until unity is obtained at 60 per cent. reduction, after which an increase, itself increasing the maximum amount of increase for any pass being about 2½ per cent. Curves for these figures are shown in Fig. 16. Roughly, both for square and rectangular sections, taking successive passes, there is at start a definite decrease in perimeter, this decrease continuing to a point where the reduction is round about 50 per cent., then a steady increase until practically the original perimeter is obtained. Again, it is most significant that the amount of decrease and increase in each case is less by about one half with the wider rectangular section than with the square. It would be extremely interesting to continue these reductions further, although as annealing would then be necessary another variable factor would be introduced, and, better still, a series of tests on strip which is wide in proportion to its thickness; but even without the advantage of these further data it is safe to conclude, from the fact that, with wider section, the change in perimeter is less, that reduction on wide and thin metal would result in very little change in the perimeter. So far no satisfactory physical explanation is forthcoming for the regular and consistent effect of reductions on the sum of the lengths of the sides of the section, but for the present it is useful to take advantage of this consistency, for the purpose of calculating spread.

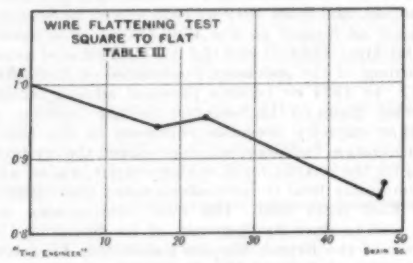


FIG. 14

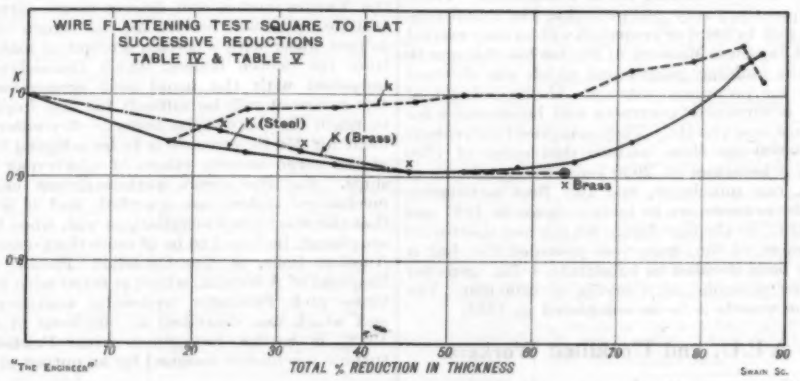


FIG. 15

Clearly the constants K and *k* can be employed with much greater certainty for such a purpose than the ratios between per cent. spread and per cent. reduction discussed previously, and the formulæ for estimation of spread on this basis may be stated as follows :—

(1) *Round to Flat.*

D = diameter before rolling.
T_2 = thickness after rolling.
W_2 = width after rolling.
$K \pi D = 2 (W_2 + T_2)$
$\therefore W_2 = (\frac{1}{2} K \pi D) - T_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (C).$
Approximate average value of K = 1·20.

* No. I. appeared June 11th.

(2) *Square to Flat.*

Original section $T_1 \times T_1$.
Thickness after rolling T_2.
Width after rolling W 2.

$$4 K T_1 = 2 (W_2 + T_2).$$
$$\therefore W_2 = (2 K T_1) - T_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (D).$$

Approximate Average Values of K.

One reduction square to flat K = ·9.
Successive reductions (steel) K = ·92.
Successive reductions (brass) K = ·93.

Note.—These average values are applicable to cases of reductions not exceeding 50 per cent.

(3) *Rectangular Section* (width twice thickness) to flat.

$$2 K (W_1 + T_1) = 2 (W_2 + T_2).$$
$$\therefore W_2 = K (W_1 + T_1) - T 2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (E)$$

Approximate average value of K for reductions up to 50 per cent. (successive reductions) K = ·96.

The formulæ given above are simple and easily applied in practice, and provide the most convenient method of estimating the spread in any case of cold rolling from the section which have been considered.

The accuracy of results depends solely on inserting the correct value of K for the particular conditions; the average values selected will give very close approximations within a wide range of reduction. For greater accuracy reference should be made to the tables or curves and the value of K given for the conditions nearest those under consideration should be taken. Curves showing the variation in perimeter with successive passes for the three different sections tested are plotted together for comparison in Fig. 17. In a similar manner the spread for any intermediate pass, in a series of successive reductions, can be calculated, substituting the coefficient *k* for K. Such reductions are always a case of reduction from an approximately rectangular section to flat, or flat to flats of a thinner gauge and the formula is as (E) above:—

$$W_2 = k (W_1 + T_1) - T_2.$$

The values of *k* to be taken from the table or the curves if accuracy is required, but sufficiently close approximations can be obtained by using the following average values:—

Initial section round	k = ·99.
Initial section square	k = ·913.
Initial section rectangular (2/1)	k = ·955.

It is interesting to note from the above that the shape of the original section would appear to have some influence on the spread in succeeding passes. Also for reductions after a total of about 50 per cent. of the original thickness has been taken, the perimeter remains practically constant, and *k* for all forms of initial section may be taken as approximately unity.

The actual amount of spread is greater when flattening from round than when rolling from square of the same dimensions, whether reduced in one pass or in a series of passes; but comparing square with a rectangular section when the thickness of the rectangle is equal to the side of the square and the width of the former, twice the size of the square, the actual amount of lineal increase in width is greater in the case of the rectangular, but owing to the greater initial width of this section the ratio which this spread bears to the original width is less than in the case of the square. As previously mentioned, as the reduction proceeds, until the section obtained becomes an elongated rectangle—that is, with a thickness which is small compared with its width—the value of K or *k* approaches unity, and in certain cases of extreme reduction exceed unity. Obviously with K = 1, the perimeter is unaltered by the reduction, and the actual increase in width is then exactly equal to the amount of reduction; that is—

$$(W_2 - W_1) = (T_1 - T_2),$$

and if the difference in thickness or reduction is called *d*—

$$W_2 = (W_1 + d).$$

The per cent. spread in such a case is—

$$\frac{d}{W_1} \times 100.$$

This may be expressed more generally as—

$$\frac{K d}{W_1} \times 100,$$

and covers all cases of reduction of rectangular sections, the value of K varying from ·9 in the special case of the square to 1, or even greater than 1, with rectangles of great width compared with their thickness. This very general application of the method of calculation cannot as yet, however, be considered as proved with sections of proportions not included in the tests recorded, and it is hoped that further test on strip metal may be carried out in the near future, and that values for K may be obtained to cover all cases of cold rolling metals in strip form.

Such test would be under conditions similar to those for intermediate reduction on the tests given in the tables. Taking as an example pass No. 6 in Table VI., the section which is ·604 × ·114 is reduced in thickness to ·617 × ·1, the perimeter is nearly constant (K = 1), and the ratio of the initial width to thickness is about 5·3 : 1; while the last pass of this test (No. 11) commences with ·723 × ·035 (ratio width to thickness = about 20 : 1) and is reduced to ·744 × ·029, showing an increase in perimeter of about 2 per cent.; but judging by the last few passes it is not safe to assume that this increase in perimeter will continue; in fact, it is quite possible, or even probable, that the perimeter may decrease after a pass, and the value of K again fall below unity.

It must also be remembered that with the higher degrees of reduction in these tests the metal is rapidly hardening, and the increased tensile strength may alter the rate of spread. No annealing was done on the metal during the tests, and it is possible that heat treatment might alter the relation of spread to reduction in thickness very considerably; at the same time, within the limits of reductions carried out in usual practice, it is not very likely that annealing would have any great influence.

Referring back to the expression—

$$\text{Per cent. spread} = \frac{K d}{W_1} \times 100,$$

it is clear that, as K *d* has very little relation to the initial width W_1, and consequently the per cent. spread depends almost entirely on this original width of section, no very uniform relation can be expected between per cent. spread and per cent. reduction. This was shown by the investigations made on this ratio in the earlier portion of this article, and supports the opinion stated, that calculation based on the change in perimeter of section afford a more satisfactory and reasonable means of guidance in estimating spread under widely varying conditions.

The writer has confined his investigation entirely to the cold rolling of metals; but it is quite possible that the special case of hot rolling attacked from this same point of view may render it possible to formulate a more satisfactory method for calculation of spread than has hitherto been discovered.

Apart from the data obtained and deductions concerning the change in width resulting from the cold rolling of metal, some general conclusions may be stated:—

(1) *The Nature and Conditions of Metal Rolled* appear to have surprisingly little influence on the spread. Most of the tests recorded were carried out on steel; but the few on copper and brass which were included do not show any great difference in the amount of spread.

(2) *The Diameter of Rolls* used in effecting the reduction does make some, though small, difference in the spreading. Comparison between tests Nos. 4 and 5, Table I., in which exactly similar reductions were carried out in rolls 9in. and 4in. diameter respectively, show that a greater spread is obtained with the smaller rolls; these latter, being ·44 of the diameter of the larger, produce 2·7 per cent. greater spread.

(3) *Reduction in Thickness.*—Spread is definitely proved to increase with the reduction in thickness effected, and this factor has by far the greater influence. The fairly consistent and regular variation in perimeter of section, caused by rolling, proves that the amount of spread obtained is very closely connected with the amount of reduction in thickness.

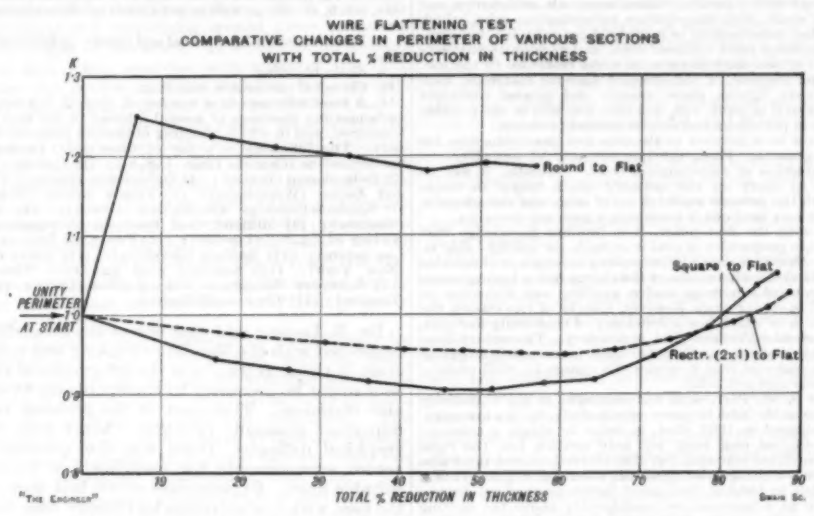


FIG. 17

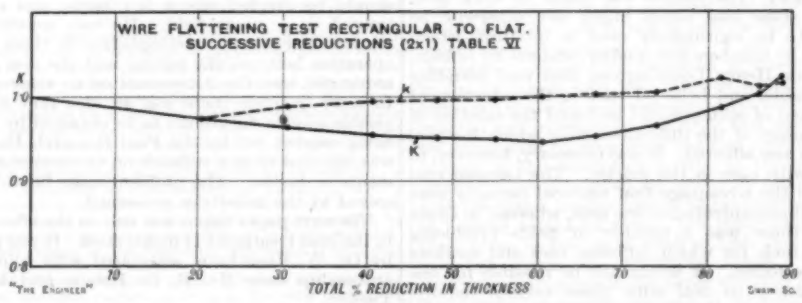


FIG. 16

(4) *Speed of Rolling.*—So far as these tests show, rolling speed has, within limits, no effect on spread. The majority of tests were carried out at a speed of about 75ft. per minute, some at the higher speed of 104ft. per minute, and over that range no appreciable difference is detected.

(5) *Condition of Roll Surfaces.*—No data is available on this point, and it can only be noted that the tests were all carried out with practically dry rolls; that is to say, only slightly greasy, without any special application of a lubricant. It is, however, believed that with ample lubrication, rolling on wider sections than those tested, some increase in the amount of spread would be obtained. This would be expected if the influence of friction between the metal in contact with the rolls and the rolls themselves is as suggested in the earlier part of this article.

(6) *Variation in Perimeter of Section.*—As explained in detail, it is believed that observation of the change in perimeter, or, what is the same thing, the sum of width and thickness of section, affords the most satisfactory basis for investigation of the spreading of metal during rolling.

(7) *Shape of Section Rolled.*—The difference of spread obtained with the same reductions on various sections has been clearly shown; in particular, that rolling from round to flat results in a greater spread than when rolling rectangular sections.

Also it should be noticed that rolls ground to camber for strip rolling tend to give a more uniform spreading effect, and probably to some extent actually increase the total amount of spread.

In publishing these test results and notes on the subject of "spread" obtained in cold rolling, it is hoped that some information of practical value may be given to those engaged in rolling metals, and that other investigators will carry out similar trials over a wider range of sections, with the view to the publication of further useful data.

Iron and Steel Institute.

No. II.*

SIR W. PETER RYLANDS presided at the resumed meeting of the Iron and Steel Institute, which was held at the Institution of Civil Engineers on June 4th.

The first business on the agenda was the announcement of the awards of Carnegie Scholarships for the year 1926. They were as follows:—

Mr. F. H. Arnfelt (Stockholm), £100 for a reserach on iron aluminium alloys.

Mr. V. N. Krivobok (Pittsburg), £100 for a study of recrystallisation of metals after cold working.

Mr. A. G. Lobley and Mr. C. L. Betts (Great Britain), £100 for an investigation on the viscosity of iron and steel at high temperatures.

Mr. A. R. Page has been awarded a grant of £100

* No. I. appeared June 11th.

to enable him to carry out a research on the hardening and tempering of high-speed steels.

Mr. Tibor Ver (Budapest) has been granted the sum of £100 to enable him to study the effect of alternating stresses on the structure and mechanical properties of metals.

Mr. L. B. Pfeil (Swansea) has been awarded a grant of £100 to continue his investigation on the growth and properties of single iron crystals.

Mr. J. H. Partridge (Birmingham) received a grant of £100 in 1925 in aid of a research on the electrical and magnetic properties of cast iron. He now receives a further reward of £50 to enable him to continue the investigation.

Mr. David Brownlie then presented a paper on coal blending, an abstract of which is appended.

COAL BLENDING.

In this paper the author attempts to present a survey of the subject of coal blending in connection with carbonisation, that is, primarily, the mixing of swelling bituminous coals with other products, such as non-swelling bituminous coals, anthracites, and anthracitic coals, high-temperature carbonisation coke, which may be either metallurgical or household gas coke, low-temperature carbonisation fuels, oxidised coals, and various constituents of coal. It is necessary likewise to make reference to the use, for the same purpose, of various carbonaceous materials, such as brown coal, lignite, shale, cannel, and general canneloid material, as well as pitch, oils, and tars, and also to the possible application of petroleum and similar natural products.

The matter is of interest to the iron and steel industries for two main reasons. First, the improvement of net efficiency in the production of metallurgical coke. Secondly, it will be impossible to carry on the industry much longer in Great Britain with the present wasteful use of coal, and the adoption of more efficient methods is becoming a national necessity.

Dealing with the first point, it is familiar knowledge that only a certain proportion of coal is suitable for coking—that is, possesses sufficient resinous or cementing constituent of suitable quality to bind the whole mass of the charge into a homogeneous and coherent coke without undue swelling and reduction in density. Non-coking coals, however, may be of two classes, the more common of which has a deficiency of cementing material, giving a carbonised residue that is powdery. The second class of non-coking coal may, on the other hand, contain such an excess of resinous material that it causes the charge to swell unduly, giving porous and soft coke.

Professor S. W. Parr, with his associates at the University of Illinois, was the first to prove conclusively, by his investigations commenced in 1902, that, in order to obtain a coherent coke, the original coal must not only contain just the right amount of resinous material, but that this constituent must also have a definite melting point, generally about 662 deg. to 842 deg. Fah. (350 deg. to 450 deg. Cent.), and the property of not decomposing until at a temperature considerably above the melting point, so that the viscous stage can be retained for some time, thus enabling thorough penetration and mixing to take place. Incidentally, it may be pointed out that the mechanical structure of the raw coal plays a more important part in the production of good coke than is generally supposed, as shown by F. C. Keighley.

The general method of blending as developed on scientific lines by Parr is of the greatest importance, as it increases very considerably the amount of coal available for the production of a high-grade coke. It is already common practice to-day to crush, grade, wash, and dry the coals, and to compress the charge in the oven before carbonisation, and by the adoption of the further process of blending great improvements result. The mechanical operation of the ovens is improved, for the use of coals with slightly too much resinous material causes a severe strain on the walls and general setting because of undue swelling, while the considerable friction and resistance on discharging increase the wear and tear and cost of repairs and maintenance.

It cannot be too strongly emphasised that in the matter of blending the British coke oven industry is lagging behind both the United States and the Continent. In America coal blending for coking is almost universal, the plants as a rule being situated at the steel works, while the coal is brought from many different districts and generally stored in different bunkers and bins, whence it is taken to the mixing chambers by means of continuous belt conveyors; or, the correct number of car loads are used for a large mix, with the balance weighed separately if necessary, so as always to keep to the exact blend which experience shows to give the best results, two of the essential factors in successful blending being accuracy and intimate mixing.

The same applies more or less to Germany, Belgium, and France, a good example being the methods now adopted in the Saar district. Of course, there are also a number of British plants in which modern blending is being carried out, but the fact remains that in Great Britain adequate attention has not been given to the subject.

Another point of great importance to the iron and steel industries is the fact that British coking plants are as a rule so small and scattered that the resulting bulk supplies of coke are not uniform in quality. It would be, for example, a much more efficient national policy to divide the colliery districts into areas according to circumstances, have a few very large modern coking plants, blend all the coal received from the many different collieries and produce a more uniform quality of coke, which probably also would allow the use of about 25 per cent. of small non-coking coal, at present practically a waste product. As regards low-temperature carbonisation, Great Britain is peculiarly well situated for scientific methods of fuel utilisation, possessing a large proportion of rich bituminous coal which would give a high yield of by-products, with the added advantage of relatively short railway journeys in comparison with other countries, especially the United States.

Again, the subject is of direct interest to the iron and steel industries on account of the improvements rendered possible in gas producer practice, as found by German experience. The low volatile fuels obtained are in general very suitable for this purpose, giving less trouble than bituminous coals, while there is much to be said for combined low-temperature carbonisation and gasification in the same setting.

The latest developments in the treatment of raw coal, according to a number of different processes, seem to be tending to the production of a smokeless fuel that possesses extremely reactive chemical properties, and is therefore of particular value for gas producers. In fact, the stage may shortly be reached when it will be the best policy in many cases to subject a great part of the coal to low-temperature carbonisation for the specific purpose of power generation by means of gas engines, and to obtain enriched producer gas from the residual fuels, with cracking or hydrogenation of the greater part of the tar oils to light fractions, in preference to using internal combustion heavy-oil engines.

The adoption of suitable carbonisation processes with the aid of blending would also be of great value in enabling coke oven installations to be usefully employed for turning out smokeless free-burning fuel for various markets in slack periods, since, with the present general methods, a large amount of valuable plant is always liable to be standing idle as the trade fluctuates.

Further, low-temperature carbonisation is becoming increasingly important for the production on the spot of a fuel for blending with any strongly swelling coal. For instance, in the Saar, a proportion of the available coals is submitted to low-temperature carbonisation, and the residual smokeless fuel, after the separation of the by-products, is blended in with the main bulk to give a dense coke, thus eliminating the cost of carriage and dependence on other areas for blending material.

Since the subject of blending in general is of formidable magnitude, for convenience and in special reference to the iron and steel industries, the paper is divided into the following sections:—

1. A preliminary reference to the blending of carbonaceous materials for purposes other than that of carbonisation, such as combustion and gasification.
2. Rare cases of certain coals, especially in relation to low-temperature carbonisation, which do not require blending, as they contain exactly the right amount of resinous material to give a homogeneous coherent coke without swelling.
3. Blending of two or more coals, that is, the general principle of mixing strongly swelling bituminous coals having an excess of resinous material with non-swelling coals deficient in this respect.
4. The use of high-temperature carbonisation coke instead of non-swelling coals for blending with strongly swelling coals.
5. The blending of swelling coals with low-temperature carbonisation fuels.
6. Application to blending of the use of oxidised or preheated swelling coals in which the coking properties are entirely destroyed and the product then used for mixing.
7. The utilisation of anthracite, anthracitic, and non-caking coals in coke production by blending with high or low-temperature tars, pitch, or oils, as well as petroleum or other similar natural products.
8. Blending in the brown coal and lignite carbonisation industries.
9. Shale blending.
10. Chemical methods in blending.
11. A brief reference to a number of typical low-temperature carbonisation processes of special interest to the iron and steel industries, and in which blending in general plays an important part. The following is a list of these:—(1) Carbocite Dual Carbonisation (Canton, Ohio, U.S.A.); (2) Coalite (London); (3) Delkeskamp (Berlin); (4) Dobbelstein (Essen); (5) Fellner and Ziegler (Westphalia); (6) Fusion Retort (Middlewich); (7) Kohlenscheidungs Gesellschaft (Essen); (8) Maclaurin (Glasgow); (9) Midland Coal Products (Nottingham); (10) Nielsen or "L.N." (London); (11) Pure Coal Briquette (Leigh, Lancashire); (12) Rafflcer (Duisburg); (13) Smith Carbocoal (New York); (14) Staveley Coal and Iron (Chesterfield); (15) Summers Continuous Coking (New York); (16) Tozer (London); (17) Thyssen (Mülheim).

Dr. R. Lessing said that one of the great difficulties connected with the blending of coking and non-coking coals in Great Britain was the geographical situation, as it might be necessary to transport coal to considerable distances. That part of the problem raised an important economic problem. Apart from the geographical difficulty, there was the question of the actual arrangements for carrying out blending on suitable lines. Experiments which had been made in the past with coal mixtures had hardly been successful in obtaining the blending which the consumer considered necessary. It seemed desirable, at least in the export trade, that blending facilities should be available on the railways; but such facilities had not been provided in the past, nor had it been possible to arrange for actual sampling of coal on modern lines to be carried out. Railway companies raised the objection that, to provide blending facilities, would dislocate traffic. Attention would, however, have to be paid to the subject raised by Mr. Brownlie. For many years foreign consumers had been in the habit of buying English gas coal, but contracts had been lost during a recent period because it was not possible to obtain in Great Britain the advantages associated with blending, and buyers were filling their requirements in countries where they could obtain the mixtures they required. Blending was common practice in the Ruhr coalfield. The selling syndicate in that field had absolute power to draw on the supplies of members to any extent desired, and had authority to direct suitable coal to be despatched from any colliery to the central loading station. The colliery management was purely technical, the whole of the commercial side being in the hands of the selling organisation. The system was found to work well, enabling some coal which might not otherwise be saleable to be legitimately used in mixtures which were sold by numbers and quality, and not by brands.

Professor Henry Louis agreed that coal blending was desirable, and believed that in the adoption of this method of selling would be found the solution of a great many of the difficulties with which the coal trade was now afflicted. It was necessary, however, to proceed with care in the matter. The German coal trade had the advantage that the coal deposits were fairly well concentrated in one area, whereas, in Great Britain, there was a number of fields producing different fuels for which different uses and markets had to be found. It would not be possible for one selling agency to deal with these various requirements, of which the Northumberland export trade and the Nottingham internal coal trade were outstanding examples. It was the diversity of British coal deposits and the varied character of the trade which would make it necessary to settle the present coal trouble on a district and not a national basis.

Mr. E. Evans agreed with the argument that blending should become a more common practice in the British industry. The problem was not, however, so simple as might appear at first sight, as, before blending could be properly carried out, a considerable financial outlay might be involved in new plant, apart from the cost to which reference had already been made of bringing coal from one field to another. When these things were taken into consideration, it might be found that the advantages of blending from the financial standpoint were very small. The whole question required to be studied most carefully, but a system which would be of considerable advantage to the iron and steel industry might be worked out.

Mr. H. M. Ridge expressed the opinion that successful coal blending depended upon the evolution of a practical system of low-temperature carbonisation. That would go a long way towards reducing the price of coke to the blast-furnace plant, and would prove a definite saving in the cost of producing pig iron and steel. Unfortunately, the very name of low-temperature carbonisation was regarded with great disfavour. It occurred to him that it might be possible to bring together under the ægis of the Iron and Steel Institute a number of those interested in the subject, and deal with it in the way that the sub-committee under the chairmanship of Dr. Hatfield had dealt with the problem of heterogeneity. Meanwhile, it appeared to him to be desirable in the near future for the Council of the Institute to arrange for a complete discussion on the question of low-temperature carbonisation.

Mr. Alfred Hutchinson laid stress on the importance of thoroughly cleaning the good-quality coke which was available in Great Britain. It was a subject which had received special attention at the works with which he was associated, and it was possible that, by a good dry cleaning process, advantages might be obtained equal to anything that could be got by blending. Consideration should also be given to the fine grinding of the material, as experience had shown that the quality of coke could be much improved by that method.

Mr. F. W. Harbord said that the problem raised by Mr. Brownlie was really one of economics, and he agreed that in very few instances would it be possible to get an ideal mixture without incurring high charges for transport. Reference was made in the paper to many low-temperature carbonisation processes, but he was probably right in saying that with one, or at most two exceptions, they were not being worked at a profit, and no process had been brought forward which was applicable on commercial grounds to British coal. Until that had been done, it was hopeless to talk of using low-temperature coke in the manner suggested. In any event, it would be a question of setting the saving on the blast-furnace operations against the cost of getting the coke.

Mr. T. P. Colclough pleaded, in any attempt to solve this problem, for a greater degree of co-operation between the blast-furnace manager and the other interests involved. He could not agree with the suggestion that the British industry was backward in methods of blending coal, as it had been practised for generations. It was quite a common thing in steel works practice to have consignments for blending purposes from different collieries, and experience had shown that a better result could be obtained from the mixture than by using the different qualities of coal separately. From the user's point of view, there was a certain disadvantage in coal blending, as, when done on a large scale, as in Germany, coal might be put into the blend which the user would not look at if any attempt were made to sell it to him separately. He suggested that the whole subject might receive the consideration of a committee of the Institute as had been proposed by a previous speaker. The problem must be studied from the scientific standpoint. He knew that in the Sheffield area, where one of the staff had had experience with the Fuel Research Board, most satisfactory results had been achieved by blending coals, and it had been found possible to make use of seams which were not considered to be worth working in previous years.

Mr. Brownlie, in replying to the discussion, said that the subject of coal blending had not been sufficiently studied in Great Britain. He agreed with the suggestions as to washing and drying coals as well as blending. His own idea was that the country should be divided into a few areas, and each area treated as a single field. He was convinced that something could be accomplished if there were co-operation between the mining and the iron and steel industries, and the determination to achieve results. In some quarters there was an idea that it was advisable to wait for results to be obtained by the work being carried out by the Fuel Research Board. He was opposed to any reliance on Government Departments or bodies. The problem must be tackled and solved by the industries concerned.

The next paper taken was one on the effect of mass in the heat treatment of nickel steel. It was presented by Dr. W. Rosenhain, associated with whom in the authorship were Mr. R. G. Batson and Mr. N. P. Tucker.

THE EFFECT OF MASS IN THE HEAT TREATMENT OF NICKEL STEEL.

The failure in service of a number of pinions, of relatively large size, from the double reduction gears of marine steam turbines has drawn attention to the influence of mass on heat treatment. The present investigation was undertaken to ascertain the manner in which the mechanical properties and microstructure of the material used for these pinions vary with the size of the heat-treated piece.

It is well known that in the heat treatment of steel the size of the piece has an effect on the properties obtained. Some tests have been carried out by E. F. Law on a steel containing 0·34 per cent. of carbon, 0·73 per cent. of manganese, 0·20 per cent. of nickel, and the usual impurities. This steel was heated in 18in. cubes and tensile tests made at regular intervals across the section. The results showed:—

(1) With air cooling the results of all these tests were practically identical.

(2) The effect of oil quenching was as apparent in the centre of the cube as at the outside.

(3) Water quenching showed a very decided variation from the surface to the centre of the cube.

Tests on the effect of heat treatment on bars varying from $^{11}/_{16}$in. to 3in. in diameter have been carried out in connection with the research of the Steel Research Committee of the Institution of Automobile Engineers and the Society of Motor Manufacturers and Traders in 1920. The tests show that there

is a reduction of the ultimate tensile stress with the larger sizes of bar.

The use of alloy steels has made it possible to obtain, in relatively large pieces, properties which would not be attainable in a simple carbon steel; this is due to the fact that certain alloying elements retard the transformations of steel, and thus make it possible to harden an alloy steel, in which they are present, by cooling at rates considerably less than those necessary in straight carbon steels. It is, however, clear that, even with alloy steels, the rates of cooling possible with ordinary methods of quenching will not be effective in hardening very large objects throughout their mass.

The tests of the Steel Research Committee on mass effect did not include a 3½ per cent. nickel steel, and the largest size of bar tested was 3in. in diameter. Further, the test pieces were taken from the centres of the bars and therefore did not give any indication of the variation, if any, in the mechanical properties of the outer and inner section of the bars. Further investigation, on the lines followed in the present research, was therefore desirable.

Particulars of the materials used in the investigation are given below :—

Lab. mark.	Particulars of sample.
ACM ..	Nickel steel pinion forging. This forging was large enough to obtain pieces up to 10in. in diameter.
AEF ..	Four bars of nickel steel, 4in. in diameter and 60in. long.
AEG ..	Four bars of nickel steel, 2in. in diameter and 60in. long.

The steels were heat treated in the form of round bars of four different sizes, viz., 2in., 4in., 7in., and 10in. in diameter, and in lengths of about 20in. The chemical analyses of the materials are as follows :—

	AEG. 2in. bar. Per cent.	AEF. 4in. bar. Per cent.	ACM. 7in. and 10in. bars. Per cent.
Carbon ..	0·364	0·370	0·306
Silicon ..	0·186	0·196	0·191
Sulphur ..	0·025	0·025	0·034
Phosphorus	0·030	0·031	0·037
Manganese	0·425	0·410	0·720
Nickel ..	3·43	3·42	3·57
Chromium ..	0·208	0·199	Trace

Mechanical Tests.—In making any comparisons between the results of the mechanical tests, it should be borne in mind that the 7in. and 10in. bars were machined from the same pinion forging, but that the 4in. and 2in. both differed slightly in composition from the former.

When full weight is given to this consideration, the results still show that complete hardening of the steel was never attained during the investigation; even in pieces 2in. in diameter the quenching effect was insufficient to give great hardness. In this size of bar the strength after quenching was only about 60 tons per square inch at both the outside and the centre, but this rose to about 80 tons per square inch on tempering at 300 deg. Cent., and subsequently fell as the tempering temperature was raised, until, after tempering at 650 deg. Cent., it was little stronger than normalised material.

A bar 4in. in diameter behaved in a similar manner, but the effect of the initial quenching was not so great, the strength being about 53 tons per square inch at the outside, and 58 tons per square inch at the centre; this rose slightly to about 60 tons per square inch on tempering at 300 deg. Cent., and fell to about 48 tons per square inch on tempering at 650 deg. Cent.; the normalised material had a tensile strength of about 45 tons per square inch.

In the pieces 7in. and 10in. in diameter the strength was not increased by tempering the hardened pieces, which were not greatly affected by this process, unless the temperature exceeded 500 deg. Cent. The 7in. bar was strengthened by quenching both at the outside and the centre, the effect at the outside being greater than at the centre. The 10in. piece was appreciably affected at the outside by quenching, but the effect at the centre was very small. In the latter case the strength of the centre was increased from 40 tons per square inch in the normalised material to 42·6 tons per square inch in the quenched piece; on tempering at 650 deg. Cent. the strength fell to 41·5 tons per square inch. It will be seen, therefore, that quenching had but a small effect on the tensile strength of this steel if the thickness of the material was 10in., and at the centre of a 10in. bar the effect was negligible.

The elongation of quenched bars was usually small; it increased at the higher tempering temperatures, but appreciable increase in strength was not obtained without loss of elongation.

The most striking results were obtained from the notched-bar tests; the quenched material possessed a low notched-bar figure compared with the normalised steel; tempering at temperatures up to 400 deg. Cent. reduced the figure slightly, but higher temperatures in all cases caused a considerable improvement, a value greatly exceeding that of the normalised material being obtained in all cases with tempering temperatures of 600 deg. Cent. and 650 deg. Cent.

This increase in the notched-bar figure could be obtained with heat treatments that gave little or no improvement in the tensile properties of the material; the improvement in the notched-bar figure was very considerable in both the 7in. and 10in. pieces.

Microscopical Examination.—The indications of the microstructure emphasise the conclusions that may be drawn from the results of the mechanical tests, viz., that the properties that could be obtained in small pieces of this steel, by hardening and tempering, could not be expected in larger masses. In the case of the smallest bar used, the diameter of which was only 2in., it was found impossible to obtain complete hardening—*i.e.*, a wholly martensitic structure—in any portion of the material, while at the centre of a bar of this size it was not possible, by oil quenching, to suppress the formation of a ferrite network, and the advantages of the maximum refinement of structure could not therefore be obtained.

The effect of heat treatment on the structure and properties of the steel was quite marked, in so far as the outer portions of the material were concerned, even in the case of the largest pieces tested, whose diameters were 10in., although in a bar of this size the effect was not very great. In the centre of the bars the effect was much less than at the outside, and in the case of a bar 10in. in diameter the centre was little different, either in microstructure or mechanical properties, from the normalised steel.

Mr. J. H. S. Dickenson said that the work described would be most important to the steel industry if the paper could be accepted as a reliable document. It described work carried out at the National Physical Laboratory at the request of a Government Department, and it might be assumed that the results would be carefully studied by those engaged in the manufacture of large forgings. A careful examination of the paper, however, revealed some serious flaws, both in the scheme of investigation and the actual results obtained. Dr. Rosenhain referred in the early part of the paper to an investigation carried out by the Institution of Automobile Engineers, in conjunction with the Society of Motor Manufacturers and Traders, with which he (Mr. Dickenson) had been associated. In the course of that work, tests were carried out on twenty different steels, on much the same lines as in the research at the National Physical Laboratory, and the data put forward from the research for the Institution of Automobile Engineers had never been controverted, and had been regularly used and accepted. Care was taken in that research to secure uniformity of the material which was to be subjected to various forms of treatment and test. At the National Physical Laboratory three different steels had been used, in which there were variations in the carbon content and in the contents of chromium and manganese. Those who were in the habit of making investigations on 3 per cent. nickel steel knew the effect of these variations, and, in his opinion, the report was full of discrepancies. One result of the employment of different steels was that the mass graph which lay at the root of the whole thing could not be made. It was stated that the 7in. and 10in. bars were cut from the same pinion forging, but it was important to know from what part of the pinion they were taken, as they might be of quite different composition. He would have thought, too, that in the case of work of that kind carried out for a Government Department something would have been said as to the origin of the steel. It would be interesting to know also if any analyses were made of the 10in. bar, near the centre and the outside, for example. Without information of the kind he had indicated, the report was not one which could be accepted by steel makers. Referring to the results given, a marked rise in the tensile strength was shown on tempering the 2in. diameter bar at 300 deg. Cent., but that effect was not revealed in the larger bars. That was a most extraordinary result, and it certainly did not happen in works practice. Indeed, if it happened in the shops there would be something like a court-martial. He suggested that that remarkable result was due to the fact that some of the bars were not properly hardened.

Dr. D. Hanson took up some of the points made by Mr. Dickenson. The investigation was, he said, undertaken by special request to ascertain what properties might reasonably be expected in large pinions, because the information was not available. The research arose out of some failures in turbine gearing. It was shown, however, that these failures were not due to any particular weakness of the steel. Referring to Mr. Dickenson's assertion that the variation in composition of the materials used made it impossible to draw any useful conclusions from the work, he claimed that something of value to the steel industry and to users of steel had emerged from this investigation. What had been put on record indicated the qualities which might be expected in pieces of steel varying from 2in. to 10in. Notwithstanding differences of composition, the main conclusions reached were quite constant.

Mr. J. A. Jones agreed with Mr. Dickenson that there was something very remarkable in the results given in the paper. He admitted the difficulty of obtaining uniform composition in the case of nickel steel, but even allowing for that fact he thought there was something wrong in the methods of testing which accounted for some of the figures given. Tested by the Brinell hardness numbers given in the tables, the fall in hardness shown was of a very curious character. It was well known that the variation of manganese content had a definite effect on the properties of that particular nickel steel in the oil-hardened condition.

Mr. H. Brearley supported the criticisms of Mr. Dickenson. He could not understand how a research worker could set about the determination of the influence of mass in the material and then introduce other variables. If in two otherwise identical steels there was a variation of only ·2 per cent. in the chromium content, the variation in tensile strength in the hardened bars was from 10 to 20 tons. Referring to the difference between works and laboratory practice and its effect on results, it had been shown in his experience to arise from the fact that the rate of heating in the laboratory would, in the case of the smaller pieces employed, be relatively quick, whereas with the larger masses used in works practice the rate of heating would be slow. The tempering temperatures given in the paper were so high that they only just fell within the hardening range. The most startling result given in the paper was that a hardened 2in. bar had a tensile strength of 60 tons, while the same, or an indentical, bar heated to 300 deg. Cent. had a tensile strength of over 80 tons. Those engaged in the research had made either a great discovery or a great blunder. His experience, extending over a period of twenty years, suggested that the effect of tempering at 300 deg. Cent. was to bring about a reduction of the tensile strength. He agreed with the criticism that the discrepancies which the report contained must be due to lack of experience in carrying out heat treatment.

Dr. W. H. Hatfield thought that the reference in the paper to failures of double reduction gearing was now unnecessary, but he was glad to have received the assurance that any failures which had occurred in double reduction pinions was not due to any inherent defect in the steel. It was now known, of course, that the trouble lay on the mechanical side. He had a great respect for the National Physical Laboratory, which occupied a position of great importance and had done some extremely good work. He regretted that in this instance he was compelled to associate himself with the criticisms of Mr. Dickenson and Mr. Brearley, and to say that the results given were misleading and not in conformity with the data obtained in works and works laboratories. It was a serious matter when a Government Department applied to a national institution for light on a particular subject and results of that character were presented. Nickel steel was now made in considerable quantities, and in large masses, and he thought it could be said that neither steel makers nor users were under any misapprehension as to what values and qualities could be obtained in that steel. It was really unnecessary for the National Physical Laboratory to devote its time to research of that character, when the energies of its staff could be more usefully employed in the production of fundamental data. The staff of the National Physical Laboratory would always find those engaged on the industrial side willing to assist in every way. British firms were not unwilling to publish results of investigations by their research department, but the men engaged in that work, unfortunately, lacked the time to publish as many results as they would desire. The paper could not be accepted as giving a correct indication of the effect of mass in the heat treatment of nickel steel.

Mr. T. M. Service also associated himself with the criticisms which had been made. It was quite evident that Dr. Rosenhain and his collaborators had no idea how to heat-treat the material, and it was not possible to take the paper seriously.

Mr. T. H. Turner asked if the authors would give the chemical analysis of the inside and outside of the material used in the experiment. That would give useful information and enable some of the results to be checked.

Colonel N. Belaiew questioned whether complete hardening of the steel was ever attained during the investigation, and said that that doubt justified the exception which had been taken to the results put forward.

Dr. Rosenhain replied to his critics in a speech of some length. He said that he could not understand why the whole band of steel metallurgists had chosen to criticise the paper in so severe a manner. The main contention was that the results did not agree with previous results. He would point out that the paper was put forward as a statement of facts, and he thought there could be no question of the accuracy of the facts recorded. Exception had been taken to the particular result on tempering at 300 deg. Cent., and objection had been raised that the difference in composition vitiated the results. He contended that it was impossible to get uniform composition right through a 10in. bar. Viewing the matter in a broad light, he would say that it was a favourite trick of the steel metallurgist, when he was confronted with results which he did not like, to blame the steel which was used in the experiment. It would have been a more useful contribution to the discussion if the critics had tried to find explanations for the facts recorded. He could say to those who challenged the results that they could be repeated. Whether they had any practical bearing or not was another matter. He repudiated the statement that only in steel works could correct heat treatment be carried out; on the contrary, the heat treatment done in steel works was often far from satisfactory. The tone of the discussion was unfortunate at a time when hopes had been raised of a better understanding between the scientist and the practical metallurgist. He had the greatest confidence in the accuracy of the heat treatment and the mechanical tests of the specimens, and, in his opinion, there was no reality in the criticism that the results were unreliable. The National Physical Laboratory was asked to do the work, and there were doubtless good reasons behind that request.

Mr. I. G. Slater presented the paper by himself and Mr. T. H. Turner on "The Hardness of Carbon Steels at High Temperatures." An abstract of the paper is given below :—

THE HARDNESS OF CARBON STEELS AT HIGH TEMPERATURES.

A recent inquiry, from a well-known firm, regarding the relative hardness of certain rivets at the temperatures employed in practical shipbuilding, resulted in the authors carrying out impact hardness determinations upon three typical samples having different chemical compositions. It had been suggested that rivets made from modern steels of higher tensile values would be harder to drive than the usual mild steel types. The impact hardness values which the authors obtained upon the samples received were found to show considerable variations at temperatures between 700 deg. and 1000 deg. Cent. This temperature range probably includes that employed in practice during the major part of the operation.

The authors conclude that, if riveting takes place between 800 deg. to 1200 deg. Cent., the higher the carbon content, up to the eutectoid composition, the harder to drive will the steels be. The results indicate also that, if the danger of burning can be avoided, there is a distinct advantage to be gained by using the higher temperatures—at least so far as the energy required in shaping the rivet is concerned. For example, a medium carbon steel rivet will be as soft at 1100 deg. Cent. as a wrought iron rivet is at 900 deg. Cent.

It is important, so far as the practical value of these results is concerned, to note that work, such as cutting off fins, done below 800 deg. Cent. will in all cases require an expenditure of much more energy than would the same operation carried out with the metal above this temperature. This difference is very marked in the steels of higher carbon content.

In the process of riveting by hammering a cooling rivet it is thus clear that, with hammer blows of equal force, the first impact will produce more of the desired shaping than will any one of the subsequent blows, and the number of rivets driven per hour will depend more upon the speed with which the first blow is struck than upon the total physical energy expended.

Mr. H. O'Neill drew attention to the fact that a round-nosed tool seemed more capable of deforming the metal at high temperatures than at lower rela-

tively to the amount of deformation caused by a flat-nosed tool. It was probable that the amount of strain produced would generally vary with the temperature, but the problem was certainly bound up with the question of round and flat-nosed tools when soft and hard materials were tested by impact.

Mr. F. W. Harbord, who occupied the chair in the absence of the President, commented on the value of the paper, which was a specimen of the good work which Mr. Turner, following in the footsteps of his distinguished father, was now carrying out.

Mr. A. R. Page briefly introduced a paper, of which we give the author's conclusions :—

THE HARDENING AND TEMPERING OF HIGH-SPEED STEEL.

High-speed steels are well known to be very complex alloys, a fact readily grasped when it is considered that even simple types contain elements such as tungsten, chromium, and vanadium, in addition to those usually found in plain steels, while the newer varieties also contain cobalt, molybdenum, &c. Owing to this complexity only one type of steel has been dealt with, the two steels experimented upon being similar in every respect except for carbon percentage. One steel, denoted by the symbol J1, is that which, in Great Britain, is probably the most popular, and has already received a considerable amount of attention from scientific investigators. It has the following approximate composition :—

	Per cent.
Carbon	0·55–0·65
Silicon	0·20
Tungsten	13·0–14·0
Chromium	3·0–4·0
Manganese	0·4–0·5
Vanadium	0·25–0·50
Sulphur	0·05
Phosphorus	0·06

The other steel on which some tests have been carried out, designated J2, is exactly similar to J1, except that the carbon content is 0·70 to 0·80 per cent.

The main conclusions to be drawn in comparing the results obtained with the two steels are :—

1. The increase in carbon content of 0·1 to 0·15 per cent. in a 14 per cent. tungsten high-speed steel causes a diminution in the temperature required for correct hardening, the reduction being something like 100 deg. Cent.

2. The effect of temperature on the hardened structure is much more marked with the higher carbon steel, the production of an overheated structure being effected much more easily.

3. The same applies to the production of the intercrystalline eutectic constituent, which appears to resemble closely the eutectic formed in high-speed steel cooled from fusion. The production of this constituent is apparently due to incipient fusion which takes place at the crystal boundaries.

4. The presence of this intercrystalline constituent appears to cause excessive brittleness in the hardened material.

5. The range of temperature and time for hardening the higher carbon steel is greater than for the lower carbon material. With the specimens experimented upon, between 1150 deg. Cent. and just over 1200 deg. Cent., and five to ten minutes, according to the temperature, appears suitable for J2 steel, whereas with the J1 steel 1250 deg. Cent. or just over seems to give the best results. If this temperature is exceeded by any appreciable amount the time necessary is reduced to such a short period as to reduce the factor of safety in commercial hardening.

6. The higher carbon material is considerably more brittle when hardened.

7. A peculiar microstructural effect is evident in the specimens which are not quite hardened—that is, those which, though showing a high hardness figure after hardening, lose their hardness rapidly on tempering. A stage further in the hardening causes the troostite to disappear gradually. The next step is the reduction of this constituent with the initial formation of the austenite crystal boundaries. The production of this troostitic material appears to coincide with the so-called carbon hardening of the steel, which takes place before the true red-hardness properties of the material are developed.

8. The conclusion already arrived at with the J1 series is confirmed in this higher carbon series—namely, that hardness and fracture in the hardened state are no criterion of the material having been correctly hardened to produce the red-hardness property.

Mr. H. O'Neill said the author had realised that the Brinell results obtained with a steel ball were not of any great value above 600. Some tests with a diamond ball, of 1 mm. diameter, which had been made recently on some very hard steel specimens, brought out very clearly the unreliability of Brinell tests on steel giving high hardness numbers. Brinell tests with a steel ball gave a hardness figure of 670, whereas the result with the diamond ball using standard loading conditions gave a hardness number of 875.

Professor Thomas Turner thought the work of the author would prove very useful. His method made it possible to adopt a graphical method, which showed results in a very simple way. He had placed before them some valuable information in an easily accessible form. The author had had wide experience, and his results could be accepted with confidence.

Colonel N. Belaiew, referring to Fig. 17, in the paper, and the high temperature indicated as having been employed, desired to know how closely that approached the fusing temperature of the material.

Mr. Page expressed agreement with the statement that the ordinary ball test when used for very hard materials did not give a true figure for hardness. By the use of a small ball it was possible, however, to eliminate to a great extent the effect of the shallow impression. He was much interested in Mr. O'Neill's figures of 670 with the steel ball and 875 for the diamond ball. They confirmed some results obtained by another method in which the diamond ball was not used. His own experience in practice confirmed some of the results given in the paper, and it had been possible to correlate some of the experimental figures with the actual behaviour of the material.

The last paper brought up for discussion was that by Mr. R. H. Greaves and Mr. J. A. Jones, on "The Ratio of the Tensile Strength of Steel to the Brinell Hardness Number."

TENSILE STRENGTH AND BRINELL NUMBERS.

The ratio of tensile strength to Brinell hardness number is dependent on the hardness of the material and on its yield ratio. Since all steels of the same hardness do not give the same yield ratio, the ratio is to some extent dependent on composition and heat treatment. For a given class of steel the ratio decreases with increase of yield ratio, and also decreases with increase of hardness up to 375 to 450, depending on the composition of the steel. In material of greater hardness it rises again.

The table given below summarises the ratio of tensile strength to Brineli hardness number calculated from data obtained in the Research Department, Woolwich, and from the sources indicated. Values of the ratio deduced from three published tables of Brinell hardness number and corresponding tensile strength are added for comparison.

From this table a close approximation to the correct ratio for any hardness can be obtained, but in practice it is often desirable to make use of a simple factor which can be easily remembered. The values recommended are :—

(1) For heat-treated alloy steels, with a Brinell hardness of 250–400 .. .. 0·21
(2) For heat-treated carbon steels and for alloy steels with a Brinell hardness below 250 .. 0·215
(3) For medium carbon steels, as rolled, normalised, or annealed .. .. 0·22
(4) Mild steels have not been examined in the Research Department, Woolwich, in sufficient number to make it possible to give a definite ratio, but published work indicates that 0·23 is a suitable value to adopt for these steels as rolled, normalised, or annealed.

These ratios do not apply to severely cold-drawn nor to austenitic steels.

The British Engineering Standards Association suggests for general purposes a ratio 0·22, while the corresponding German Association recommends :—

For carbon steels, tensile strength 19 to 63·5 tons per square inch .. .. 0·23
For alloy steels, tensile strength 41 to 63·5 tons per square inch .. .. 0·215

Systematic users of Brinell hardness tests are well aware of the differences in the Brinell hardness number determined with reasonable accuracy at points a short distance apart in the same specimen. These differences give a numerical indication of actual variations in properties from point to point and are useful as an indication of the departure from uniformity of a piece of steel, but they are a source of error in determining the ratio of tensile strength to hardness number unless special precautions are taken. Thus it is rarely that the value of the ratio for a series of steels is known with a probable error of less than ± 0·003. The existence of this probable error is a further argument for the use of an approximate ratio in round numbers. Until the probable error is reduced, the accuracy with which the forecast of tensile strength can be made from the Brinell hardness number is but little affected by the use of an approximate rather than the true mean value of the ratio.

Professor Turner said that it should be understood that in dealing with materials other than those covered in the work described the ratio would be different, but the author's figures could be adopted under allied conditions and with similar materials.

Mr. Greaves, in reply, said that the ratios given did not apply to severely cold drawn or austenitic steels, nor to non-ferrous metals.

The other papers on the agenda for the meeting were taken as read. They included the following :—"The Effects of Arsenic on Steel," by Mr. A. E. Cameron and Mr. J. B. Waterhouse ; "Specific Resistance and Thermo-electromotive Potential of Some Steels Differing in Carbon Content," by Mr. E. D. Campbell and Mr. H. W. Mohr ; "Magnetic Changes in Iron and Steel Below 400 Deg. Cent.," by Professor Carl Benedicks and Mr. W. H. Deardon ; "On the Combustibility of Coke and Direct Reduction in the Blast-furnace," by Mr. W. W. Hollings ; "Deformation Lines in Large and Small Crystals of Ferrite," by Mr. H. O'Neill ; "The Relation Between Space-lattice Constant and Density of Iron-nickel Alloys," by Mr. A. Osawa ; "The Estimation of Phosphorus in Steels Containing Tungsten," by Mr. T. E. Rooney and Mr. L. M. Clark ; "Ghost Lines and Banded Structure of Rolled and Forged Mild Steels," by Mr. J. H. Whiteley ; and "Influence of Segregation on the Corrosion of Boiler Tubes and Superheaters," by Mr. G. R. Woodvine and Mr. A. L. Roberts.

TABLE.—*Value of the Ratio of Tensile Strength to Brinell Hardness Number.*

Brinell hardness number, 10 mm. diameter ball, 3000-kg. load.	Carbon steels.			Alloy steels.				From tables.		
	Research Department, Woolwich.	Inst. of Automobile Engineers' Research Committee.	Shepard.	Research Department, Woolwich.	Inst. of Automobile Engineers' Research Committee.	Gillett and Mack.	Strauss.	Hadfield.	Brearley.	Hanby.
150	0·223	0·229	—	—	—	—	—	0·240	0·229	0·228
175	0·218	0·221	—	0·214	0·217	—	—	0·234	0·224	0·230
225	0·215	0·216	0·212	0·211	0·213	0·224	—	0·227	0·220	0·215
275	—	0·212	0·218	0·211	0·215	0·217	—	0·218	0·217	0·217
325	—	—	0·220	0·210	0·218	0·214	0·214	0·212	0·218	0·215
375	—	—	—	0·212	0·220	0·219	0·211	0·211	0·219	0·216
425	—	—	—	0·213	0·222	0·222	0·210	0·216	0·219	0·217
475	—	—	—	—	—	—	0·222	0·225	0·218	0·214

The meeting concluded with the customary vote of thanks to the Institution of Civil Engineers for the facilities afforded for holding the meeting.

The autumn meeting of the Institute is to be held at Stockholm from August 26th–28th, on the invitation of the Swedish Ironmasters' Association. The meeting will be followed by excursions to various ironworks and mines in Sweden.

Mr. E. Kinander and Mr. A. Grabe, representing the Swedish Ironmasters' Association, were present at the London meeting, and the former offered, on behalf of the Association, a warm welcome to all members of the Iron and Steel Institute who could accept the invitation to attend the Stockholm meeting.

Foundry Trades' Exhibition.

THE International Foundry Trades' Exhibition, which was opened by Sir Robert Hadfield on the 10th inst., and closes to-morrow, the 19th, is the fourth of its kind to be held in this country, and is taking place this year at the Royal Agricultural Hall, Islington.

In view of the present difficulties with transportation it is not surprising to find that the hall is not fully occupied, as some of the prospective exhibitors found it impossible to get their machinery delivered ; but the stands are, nevertheless, well representative of the industry, and it is noteworthy that there is a good proportion of French and Belgian firms among the exhibitors. Another striking feature about the Exhibition was that it was really complete and ready for inspection on the morning of the opening day.

Before describing the machinery, we must make some reference to the technical and non-commercial exhibits.

This part of the show, which is at the far end of the hall, has been arranged with the co-operation of the National Physical Laboratory ; Woolwich Research Department ; the Universities of Glasgow, Birmingham, Manchester and Sheffield ; the British Cast Iron Research Association ; the Non-ferrous Metals Research Association ; the London Branch of the Institute of British Foundrymen ; the German Foundry Owners' Association ; and various manufacturers of scientific apparatus. The various exhibits are divided into a number of distinct sections, and each section is presided over by a scientist.

Dealing, first, with the last-mentioned in the above list, it is a rather unusual form of exhibit, taking the form of a number of charts or drawings lent by the German Foundry Owners' Association. These charts aim at showing the right and wrong ways of doing various things, such as arranging the gates and vents in moulds, the construction of patterns, and even the design of machine parts, with the object of facilitating their being cast. It frequently happens, of course, that there are several wrong ways of doing a job, but there is generally only one right way, and the Association's advice in this direction is quite sound ; it does not differ materially from British practice.

One of the most fascinating parts of the technical exhibit is that of the Research Department, Woolwich, which has been organised by Dr. H. Moore. Here one is impressed with the great advances which have been made in the examination of metals by means of X-rays. It is, for instance, now possible to take a photograph through 4·43in. of steel and to get such a good image that a hole $\frac{1}{4}$in. in diameter is clearly discovered. In other words, a cavity representing only 3 per cent. of the thickness of the metal is revealed on the plate. When photographing through 4in. of steel the penetrating power of the X-ray tubes now available is nearly expended, so, in order to demonstrate the fact that the rays have actually passed right through the metal, and produced an impression on the sensitive plate, a little figure of lead is placed on the top of the specimen, and if its image appears on the plate, it is obvious that penetration has been complete. It occurred to us that an inexperienced operator might be led to ascribe some of the marks on a negative to defects in the exposed plate, rather than in the metal examined, and asked if that was so. There is, however, a very good assurance against such errors. The plate is sensitised on both sides, and the print is taken through both films. It is obvious that any defect in one film is very unlikely to be duplicated in the other film, and this source of confusion is eliminated.

On another part of this stand there is a collection of specimens illustrating research which is being carried out by the British Non-ferrous Metals Research Association with the object of improving the quality of rolled brass strip. The specimens are beautifully polished, and show the structure of the metal admirably. The effects of different methods of casting the ingots are illustrated, and some samples of a brass alloy which resists corrosion and oxidation are displayed. Some other specimens show, by means of composite ingots built up of alternate layers of brass and copper, how the metal flows, in being forced through an extruding press, and how the surface defects of the ingot tend to take their place in the interior of the extruded bar.

The exhibits of the National Physical Laboratory,

Teddington, which have been organised by Dr. W. Rosenhain, are principally concerned with high-temperature processes. They include an alundum furnace tube, shown in operation, which is capable of working at temperatures up to 1400 deg. Cent. It is heated by six Silit resistance elements, supplied by the Electrical Equipment and Carbon Company, of New Oxford-street. Another furnace shown is

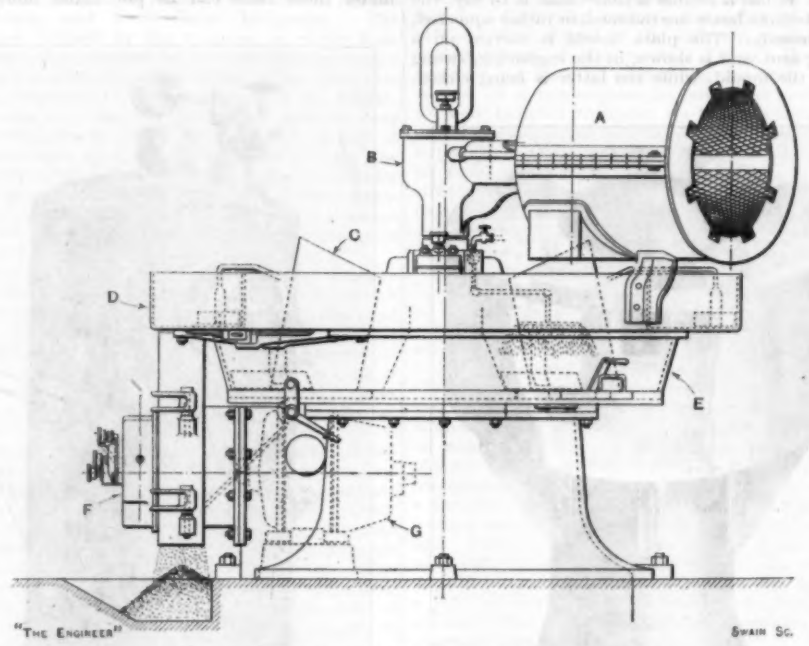


FIG. 1—FOUNDRY-SAND-PREPARING MACHINE—EVANS

of the high-frequency type, and is capable of melting some 20 lb. of iron or copper alloy. In it electric currents are induced within the charge itself by alternating currents in an enveloping water cooled coil, so that the charge can be raised to a high temperature in a totally enclosed space, without any fear of contamination. There are also some very pure specimens of chromium, manganese, beryllium and iron prepared at the laboratory by special methods for research work.

Among the other exhibits in this section there is a variety of specimen refractories, showing, for instance, the effect of the proportion of lime in silica bricks, and the change in texture and toughness on repeated burning. There is a good collection of scientific apparatus, such as hardness testers, temperature recorders, pyrometers, microscopes, and photomicrographic apparatus; while the exhibits of the British Cast Iron Research Association are typical of the work carried on by that body.

Close by the technical section there is a stand which attracted our attention, but, unfortunately,

FIG. 2—SAND SIFTER—BRITANNIA

we could not gain much information there. It is that of the Anglo-American Steel Company, 66, Victoria-street, S.W. 1, and it displays a number of specimens of steel which, it is said, have been made directly from the ore without the intervention of a blast-furnace. All we could glean was that the process involved the magnetic separation of the ore and its treatment in an electric furnace. The cost of manufacturing the steel is said to be one-third that of steel made in the ordinary way, and test results indicate that it is of excellent quality.

Coming now to the machinery in the hall, Fig. 1 is a sketch of a foundry-sand-preparing machine, made by MM. T. Ketin and R. Thiriart, of Sclessin, Liége, Belgium, who are represented in this country by Mr. S. Evans, of 9, Bush-lane, Cannon-street, E.C. 4. The peculiarity of this machine lies in the fact that on one base there are combined the functions of a sifter, a mixer, a mill and a disintegrator. On reference to the illustration it will be seen that there is a rotary sifter, or trommel A, into which the rough sand is shovelled. The mesh of this sifter is sufficiently fine to keep back any ordinary pieces of scrap iron or foreign matter, but in some instances it is equipped with magnetic bars to ensure that no iron at all is passed on. The trommel is driven by bevel gear in the head B, and discharges into the pan D. Round this annular pan there works a series of scrapers and ploughs, which thoroughly mix the sand and ensure a homogeneous product. When the sand is thoroughly mixed, a sliding door is opened in the bottom of the pan and the material falls into another pan E below. In this pan the sand is subjected to the milling action of two rollers, which are peculiar in that their peripheries are formed of a series of diagonal bars, instead of a plain surface. These rollers are, by the way, conical and one of them is indicated at C in the sketch. There is also a pair of rotary spray pipes with which the sand can be moistened, if necessary. After the sand has been properly incorporated in this second pan, it is discharged into a disintegrator F, which comprises a plate, fitted with projecting pegs, rotating at a high speed in company with a correspondingly pegged fixed plate. The sand drops out of the disintegrator on to the floor, ready for use. The whole machine is driven by an electric motor G, which is of 8 horse-power in the case of a set capable of delivering 3 tons of sand per hour. It is noteworthy that the disintegrator F is mounted on a simple hinge, so that it can be readily swung open for cleaning, that ball or roller bearings are used wherever possible, and that the whole machine can be picked up bodily and moved about the foundry by means of the eye on the top of the central spindle. Its total weight is 3½ tons.

The Britannia Foundry Company, of Coventry, has a large stand, on which there are shown in action a variety of moulding machines, most of which are familiar to our readers. They include jar ram and jolt squeeze machines worked by air pressure, and a hand power moulding machine, with which a force of some 5 tons can be exerted on the mould. It is

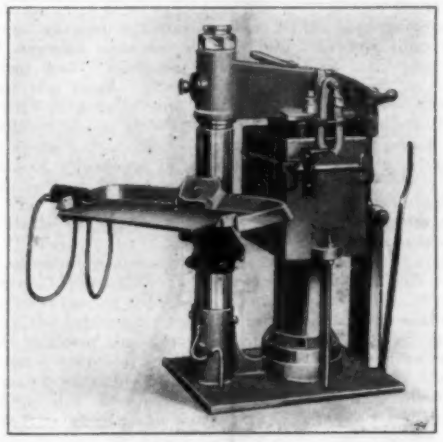


FIG. 4—HIGH-SPEED MOULDING MACHINE—UNIVERSAL

intended for boxes up to 18in. long by 16in. wide, and gives 6in. of draw to the pattern. There is also on this stand the pneumatic sand sifter illustrated in Fig. 2. The operation of this sifter is so obvious from a glance at the illustration that little description is necessary, but its capacity is not so palpable. When it is working a "half-inch" riddle, the machine will easily keep pace with a man shovelling the sand in. The height is 3ft. 1in., and the diameter of the riddle is 1ft. 6in. The air pressure required is 80 lb. per square inch, and the weight of the machine is 2 cwt. It will be seen that the pivots of the rods which support the weight of the riddle frame are well protected from the falling sand.

On the stand of the Selson Engineering Company,

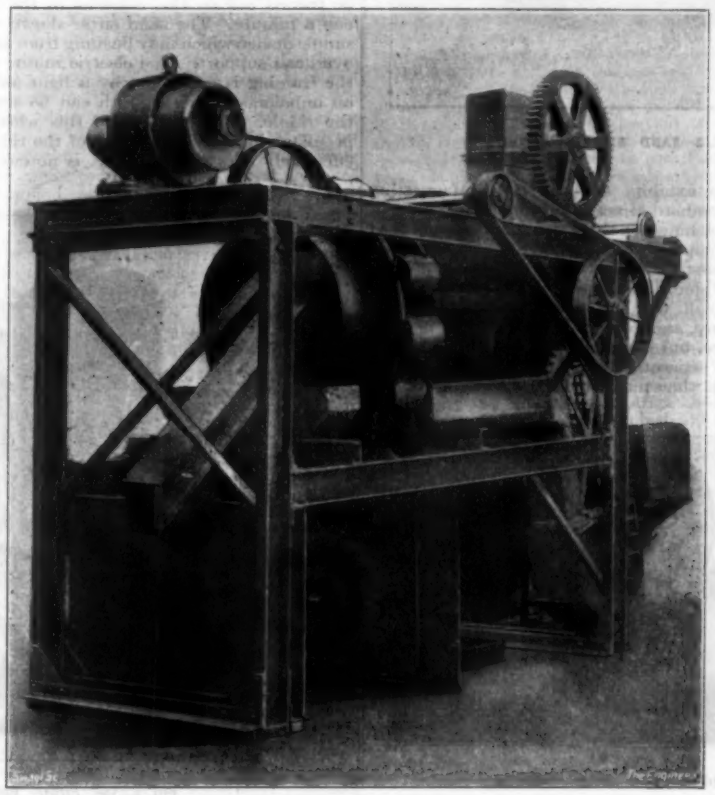


FIG. 3—MAGNETIC SAND SEPARATOR—RAPID MAGNETTING CO.

Charles-street, London, E.C. 1, there are some interesting specimens of work carried out by a new cutting-off machine, but unfortunately the machine itself is not shown. It is intended for cutting-off risers and similar work in the foundry, and depends for its action on the heating effect of a rapidly rotating disc, in much the same manner as do the cutting-off machines used in rolling mills. This is, however, we believe the first occasion that the principle has been applied to cutting cold iron castings. It has the great

merit that hard spots in the casting or sand cores are cut through as readily as the metal itself. The machine, we understand, will cut through an iron casting 6in. in diameter in about 160 seconds, and is driven by a 60 horse-power motor. There are, however, two smaller sizes of about one-half and one-third of that capacity. On this stand there is also shown a large range of abrasive wheels, which have been specially compounded for grinding aluminium without loading the pores of the wheel or wasting away themselves unduly fast.

In view of the claims of the Anglo-American Steel

FIG. 5—SAND SIFTER—UNIVERSAL

Company, the exhibits of the Rapid Magnetting Company, Lombard-street, Birmingham, are of interest, as machines of their manufacture are used in the steel company's process. The most imposing exhibit on this stand is, however, the foundry sand-preparing machine, illustrated by Fig. 3. We have in the past dealt with the machines made by the Rapid Company, and consequently need not enlarge upon them here, but it may be as well to explain that the magnetic separator, which is used to extract any scrap iron that may be in the sand, is of the

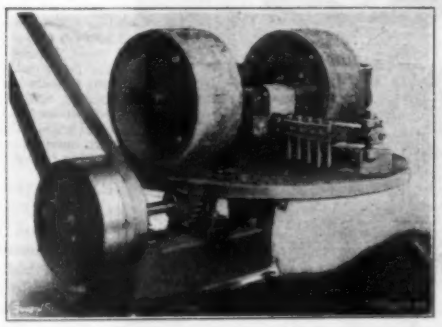


FIG. 6—SAND MILL—UNIVERSAL

shield type. That is to say, the electro-magnets are fixed in a shield which partly surrounds the exit end of the rotary drum. These magnets attract the iron to the side of the drum, and it is carried up to the top. At this point the magnetic attraction ceases, and the iron falls off into an appropriately placed shoot. From our observation of the running of the machine, it appears to be very effective and reliable.

One usually expects to find on the stand of the Universal System of Machine Moulding and Machinery Company, 97, Queen Victoria-street, E.C. 4—which stands for MM. Bonvillain and Ronceray, of Paris—an interesting demonstration of the latest French practice in foundry work, and on this occasion the display is as good as ever. We have described several of the machines now shown in connection with past Foundry Exhibitions, so confine ourselves to the three items illustrated by Figs. 4, 5 and 6. The moulding machine illustrated in Fig. 4 is operated hydraulically, and is intended for the rapid production of moulds for comparatively shallow castings from plate moulds. It has a double action—that is to say, the top and bottom boxes are rammed, or rather squeezed, simultaneously. The plate mould is carried on a swinging arm, and is shown, in the engraving, swung clear of the mould, while the latter is being closed.

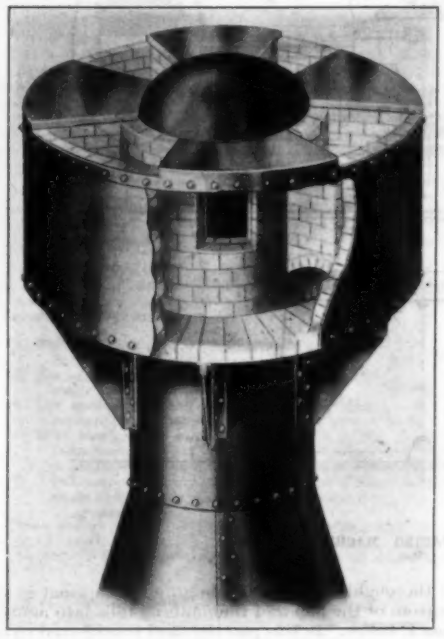


FIG. 7—SPARK ARRESTER—PNEULEC

After the two halves have been closed together, they are forced bodily through the boxes, so that the operation can be repeated with the same boxes. A light hoop iron band is incorporated in the bottom mould to hold it together. Moulds of some 17in. by 12in. can be turned out on this machine at the rate of about one a minute. The sand sifter shown in Fig. 5 is a simple device which may be hung from any convenient overhead support. The electric motor at the top of the framing is connected by a light steel shaft with an unbalanced wheel, which can be seen just above the riddle. The rotation of this wheel produces a peculiar vibratory movement of the riddle that most effectively sifts the sand. It is noteworthy that all the moving parts are well above the sand level, and consequently not subject to its abrasive action. The sand mill shown in Fig. 6 needs little comment, but differs from the general practice in that one of the rolls is ribbed while the other is plain. The pan is a plain flat plate without any lip, so that the milled sand can be readily discharged on to the floor by a ploughing action. This company is also showing some very neat little chain tackles made entirely of steel, with machine-cut gears, which are both light and cheap, and appear to be well up to their rated capacities.

A rather unusual form of hand-operated jolt moulding machine is that shown by the Denbigh Engineering Company, of Horseley Heath, Tipton. In this machine the table is guided vertically by a freely sliding stem and the weight of the table and mould are counterbalanced by a set of coiled springs in compression. In order to adjust the compression of the springs to meet different weights of mould, the springs are mounted on hydraulic rams, and the oil under these rams can be put under more or less

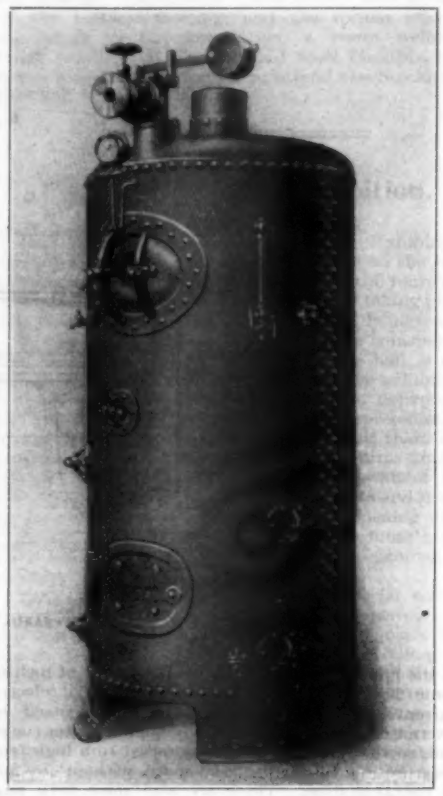


FIG. 8—VERTICAL BOILER—CONSTRUCTIONAL CO.

pressure by means of a separate ram that can be screwed down into a connecting barrel. By these means the springs are so adjusted that the table and filled moulding box are floating freely. Then a hand lever connected with a toothed quadrant and a rack on the guiding stem is used to bounce the table up and down. When the necessary knack has been attained, a surprisingly violent jar can be given to the mould as the lower end of the stem bumps down on to the base-plate. In the case of the smaller sizes of machine five or six jolts given in this way are ample to consolidate an ordinary mould, but the extent of the jolting naturally depends on experience.

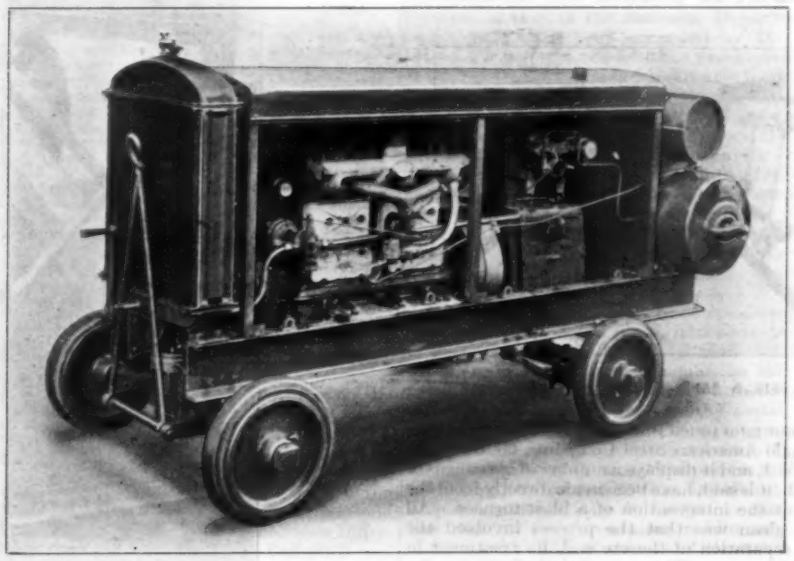


FIG. 9—100 CUBIC FEET PORTABLE AIR COMPRESSOR—BROOM AND WADE

Spermolin, Ltd., of Black Swan Works, Halifax, is a company which specialises in oil for binding the sand used in core making, and besides a number of sample cores, is showing several simple yet effective little machines for making straight cores. They are of the type in which the sand is forced through an appropriately shaped die by a conveyor screw, but are distinctive in that the table on which the cores

are received for transference to the oven is mounted on a simple form of elevating gear, so that it can be readily brought up to such a height that it catches the core without distortion as it emerges from the die. Another firm exhibiting a variety of core oils, among other foundry requisites, is Beecroft and Partners, of St. Peter's Close, Sheffield.

The International Foundry Equipment Company, of 132, Steelhouse-lane, Birmingham, has a stand dealing principally with cupola construction, besides weighbridges and ferro-silicon briquettes. The cupola put forward by this company is of the Rein type, and is characterised by the fact that the tuyeres are of comparatively small bore, while they are directed downward towards the centre of the hearth. In this way, it is claimed, the blast is made to issue from the tuyeres at a very high velocity, so that it penetrates right into the mass of the charge, the carbon-monoxide generated is burned very rapidly and a high temperature is attained. These cupolas are fitted with a special slag collector and a separate receiver for the molten metal, which is heated by gases drawn off from the top of the cupola.

Another firm showing a cupola is the Pneulec Machine Company, of Mafeking-rd., Smethwick, which is also exhibiting some moulding machines and sand mixers. The cupola is an exceptionally well-built affair, with shutters in the tuyeres that can be adjusted by a rack and pinion arrangement; but the item of greatest novelty on this stand is the spark arrester illustrated by Fig. 7. It is primarily intended for use in connection with cupolas and a working model is shown on the stand. The top of the cupola is closed by a brick-lined dome, and just below there are four openings in the sides. These openings communicate with four sections of an annular chamber. These sections, in turn, communicate with four intermediate spaces, open to the atmosphere at the top, through passages at the bottom of the dividing walls. The baffling produced in this way is very effective, and no sparks escape from the outlet. Doors are, of course, provided for the removal of the dust which collects in the arrester.

The Constructional Engineering Company, Ltd., of Charles Henry-street, Birmingham, also has a cupola, completely erected to the top, with its charging platform, &c. It has a melting capacity of from 2 to 3 tons per hour, and has a staging measuring 12ft. by 10ft. The spark arrester is of rather peculiar design, being a deflecting dome, protected by a fire-clay lining, with a deep sloping hopper terminating in a discharge shoot, for collecting the ashes. Some tests carried out by customers of the company show that the coke consumption of these cupolas, including that required for the bed, ranges from 9 to 10 per cent. of the weight of the output. The inspection doors at the back of the tuyeres are larger than is usual, and are provided with a poking hole separate from the peep hole, so that the attendant can get an uninterrupted view of the interior melting zone when poking. This company is also exhibiting some neat little vertical boilers, one of which we illustrate in Fig. 8. It is nominally of 2 horse-power, 5ft. high by 2ft. 6in. in diameter. There are 23 square feet heating surface, and it will evaporate approximately 160 lb. of water per hour. The fire-box joints are welded throughout, and the tubes are welded into place.

Broom and Wade, of High Wycombe, are showing several air compressors, including a steam-driven set capable of delivering 300 cubic feet of free air per minute at a pressure of 100 lb. per square inch, an electrically driven two-cylinder machine, and the portable unit illustrated in Fig. 9. In this set the two-cylinder compressor is capable of delivering 100 cubic feet of free air per minute at pressures up to 120 lb. per square inch, and is driven by an Aster petrol engine running at 600 revolutions per minute. The connection between the engine and compressor is made through an automatic centrifugal clutch, so that the engine can be started up light and gradually pick up the load as it gains speed. The standard equipment includes a steel housing with detachable sides, sprung axles and internal expanding brakes on the rear wheels of the carriage.

Among the other exhibitors there are the Fordath Engineering Company, of Hamblet Works, West Bromwich, which has a new form of mill for mixing sea sand and oil together for core-making purposes, together with a number of made cores; Major, Robinson and Co., of Sykes-street, Chester-road, Manchester, with a handy form of tube bender for bending light tubes up to 1in. in diameter round radii of 2in., 3in. or 4in.; and Nobel Industries, Ltd., of Nobel House, London, S.W. 1, whose principal exhibit comprises samples of the Plastic Wood, with which our readers are familiar. The Monometer Manufacturing Company, Savoy House, Strand, London, is showing some furnaces, as also is the Shell-Mex Company, of Kingsway. In the latter case the furnace is shown in operation fired with oil. The Consolidated Pneumatic Tool Company, of 170, Piccadilly, exhibits some Boyer Keller pneumatic sand rammers and shakers, peculiarly adapted for foundry work, together with some arc-welding plants in operation. James Keith and Blackman, 27, Farringdon-avenue, E.C. 4, have a large collection of fans and blowers, and the Turbine Furnace Company, of 238B, Grays Inn-road, London, shows a specimen of its forced draught furnace, which has already been described in THE ENGINEER.

The Royal Society's Conversazione.

THE conversazione of the Royal Society arranged for May 5th had to be cancelled on account of the general strike. On Wednesday of this week the second of the Society's customary conversazioni was held at Burlington House, London, and, as usual, was attended by a large number of members and their friends. Following custom, a number of scientific exhibits were staged in the different rooms for the entertainment of the guests. Few of them were, however, of strictly engineering interest. Of the several of a non-engineering character over which we were tempted to linger, we took keenest interest in the stomachion or loculus of Archimedes, exhibited by Mr. R. D. Oldham, F.R.S. This exhibit, in spite of its title, was not an anatomical one. It demonstrated the reconstruction of a pastime known to have been popular with the Greeks and Romans, and for long reputed to have been invented by Archimedes. It consisted of two equal squares of wood or paper or other substance divided by straight lines in a certain way to produce fourteen pieces in all. From the various shaped pieces—all had to be used—the game was to build up pictures of men, animals and other objects. This form of pastime is known to exist in other countries—for example, China—in a less highly developed form, but while it was known to have existed among the Greeks and Romans, while even some of the figures formed were on record, the key to the division of the squares seemed hopelessly lost. A chance discovery of a fragmentary manuscript gave Mr. Oldham the clue a few years ago, and enabled him to cut an Archimedian loculus after the pattern devised 21½ centuries ago. There is only one line in the reconstruction concerning which there is any doubt. In an Arabic variation which has been discovered this line takes a different position, and seems to give a less pleasing division. The puzzle, we may add, contains features of great mathematical interest.

Below we give some brief notes on some of the exhibits of an engineering or kindred interest.

Some experiments on rotation in multiphase magnetic fields were demonstrated by Mr. W. M. Mordey. The experiments showed a strong rotation in multi-phase fields of magnetic materials which were either non-conducting in themselves or were made so by being reduced to powder and mixed with glue or shellac, which electrically separated the particles from one another. Discs or cylinders of such materials were used, including magnetite, pyrrhotite, nickel, hard cast iron and hard steel grit. In these materials no appreciable eddy currents were produced. They formed induction rotors with no windings and no induced currents. The rotation, which was attributed to hysteresis only, was in the same direction as that of metal discs or cylinders placed in the same magnetic fields. Loose powders of the same magnetic materials rotated in the opposite direction. No movement took place either with moulded discs or with loose powders of non-magnetic metals, such as copper or aluminium, showing that no appreciable eddy currents were produced in powders, even of good conducting substances.

A bore-hole alignment indicator was demonstrated by Dr. J. S. Owens. Deep bore-holes, driven by rotary drills, may deviate greatly from the vertical without the drillers being aware of the fact. To find the true direction, a clinometer and magnetic compass are required. These parts, in Dr. Owens' apparatus, together with a clock, a contact-making drum, a battery and lamps, are enclosed in a brass tube about 4ft. long, which is capable of withstanding considerable water pressure. The instrument operates in vertical, horizontal or inclined holes, and the records are made at pre-determined intervals of time on strips of sensitised paper.

A pendulum apparatus for making determinations of gravity was shown by the Cambridge Instrument Company. This apparatus comprises a support, which takes the form of an air-tight chamber, and a set of three pendulums. The pendulums are suspended with their knife-edges parallel to one another, so that they all oscillate in the same plane. Each pendulum is made of solid nickel steel, having a very small temperature coefficient, and is fitted with a knife-edge formed of a single piece of stellite, which is firmly wedged into the head. The central portions of the flat sides of the stellite are polished to form mirrors. The pendulums have very nearly equal times of vibration, the period of the half swing being little more than half a second. The knife-edges rest on polished agate planes, so mounted on a platform in the swinging chamber as to be accurately flat and true with each other. The swinging chamber is provided with devices for lifting the knife-edges of the pendulums clear of the agate planes when they are not under observation and for starting them swinging with an exactly adjustable amplitude. The oscillation of a beam of light reflected from the pendulum mirrors may either be observed visually or recorded on a moving photographic film.

Professor J. J. Guest exhibited his apparatus for illustrating the main vibrations of an autocar. Some account of Professor Guest's investigations on this subject were, it may be recalled, given in a paper which he read before Section G of the British Association at its Southampton meeting last year. The apparatus exhibited demonstrated the existence, along the main axes, of an infinite series of elastically conjugate points, points, that is, such that a vertical force applied at one produces no movement of its fellow, and such that if masses be placed at a pair of the points, each can vibrate independently of the other. One of these pairs, termed doubly-conjugate, are also related as centres of oscillation and suspension of the car body, and the angular oscillations of the car about axes through these points are independent vibrations. If a load be added at one of the doubly-conjugate points it does not alter the position of the pair. The "bouncing" and "pitching" vibrations of a car are, according to Professor Guest's investigations, appearances due to the superposition of angular motions about these doubly-conjugate axes, and "bouncing" changes into "pitching," and *vice versâ*. They are only independent if the centre of gravity and spring centre coincide. The motions about these axes are damped by viscosity independently. The unsprung weights introduce a pair of vibrations of a higher frequency, in which axle movement is conspicuous.

The results of some compression tests on single crystals of aluminium were shown by Professor G. I. Taylor. Circular discs were cut from a crystal of aluminium and compressed between parallel steel plates. When they were properly lubricated and the test was carried out in a special manner which ensured that the lubricant should be effective, the distortion was uniform through the material. The specimens became elliptical and straight lines of particles remained straight. The exhibit consisted of discs before and after compression. An enlarged photograph of one of them showed the accuracy with which straight lines remained straight after compression.

Among other exhibits we noticed a vector colorimeter, shown by the National Physical Laboratory; a photo-electric photometer, by the Clarendon Laboratory, Oxford; a method for calibrating wavemeters by means of a neon tube and tuning fork combination, by Dr. W. H. Eccles and Dr. Winifred Leyshon; and some alloy steels for various special purposes, by Sir Robert Hadfield.

THE FARADAY SOCIETY.

EXPLOSIVE REACTIONS IN GASEOUS MEDIA.

ON Monday last, June 14th, the postponed general discussion, which was arranged by the Faraday Society, on "Explosive Reactions in Gaseous Media," took place at the Institution of Mechanical Engineers. Prior to opening the discussion the President of the Faraday Society, Professor F. G. Donnan, referred to the severe loss which that body had sustained in the death of Mr. F. S. Spiers, its late secretary and the editor of its "Transactions." A vote of sympathy proposed by the President and seconded by Professor H. B. Dixon was carried. It was honoured in silence. At the afternoon session the problem of explosive reaction was considered generally, and Professor H. B. Dixon was the chairman for that part of the meeting. Dr. W. E. Garner introduced the subject by an historical survey, in which he outlined the contributions which had been made by various investigators, and indicated the great complexity of the subject. A paper on "The Ignition Point of Gases," by Professor H. B. Dixon, J. Harwood and W. F. Higgins, followed, after which the subject of "Radiation in Gaseous Explosions" was dealt with by Professor W. T. David. The question of "Ionisation in Gaseous Explosions" was discussed in a paper read by Drs. S. W. Saunders and W. E. Gardner, and in a communication from Dr. C. S. Lind, of America. At this point a short discussion took place, after which the following papers were taken:—"The Uniform Movement during the Propagation of Flame," by Professor R. W. Wheeler and Dr. W. Payman; a Note by Professor W. A. Bone on work done on "Explosions at High Initial Pressures"; and a paper by Dr. Colin Campbell and Professor H. B. Dixon on "The Explosion Wave in Cyanogen Mixtures."

The evening session, which was presided over by Sir Dugald Clerk, who gave the introductory survey, was devoted to "Explosive Reactions, considered in reference to Internal Combustion Engines." Professor W. T. David read a paper dealing with "Combustion in Gas Engines," after which Mr. H. T. Tizard made a contribution on the subject of "Explosions in Petrol Engines." The final paper to be taken was one by Flight-Lieut. C. J. Sims and Dr. E. W. J. Mardles on "The Effect of Metallic Sols in Delaying Detonation in Internal Combustion Engines." We hope to refer to these papers and the discussion in further detail in a subsequent issue. The meetings were well attended, and the visiting guests included Professor Jorissen, of Leiden University, and Professor Marks, of Harvard University.

BOOKS RECEIVED.

The Birmingham Exchange Directory of Members, Subscribers and Representatives, 1926. Birmingham: The Birmingham Exchange. Price 2s. 6d. net.

The Use of Sodium Silicate for the Sizing of Paper. By T. E. Blasweiler. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price 10s. 6d. net.

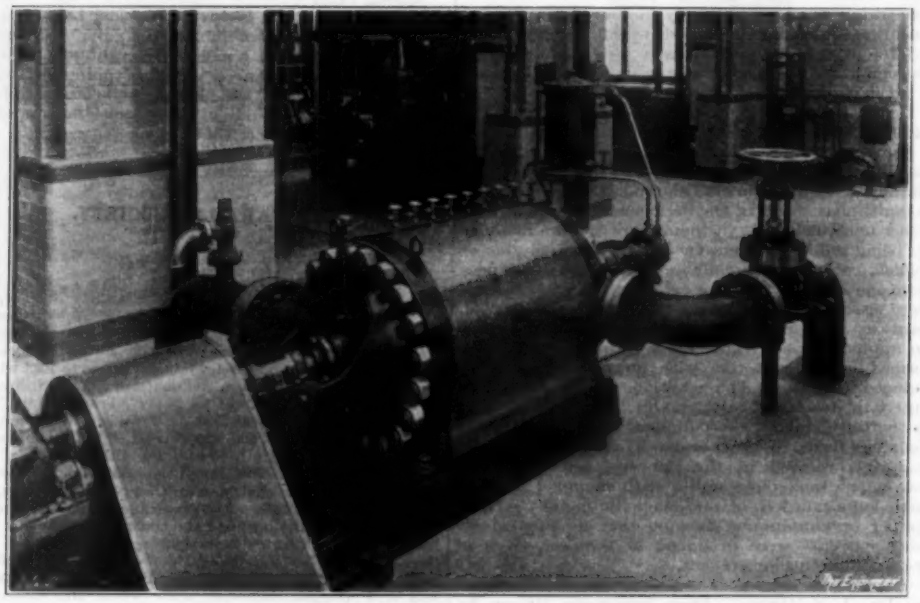
The Industrial Arts Index—Business, Finance, Science, Technology. Vol. XIV. No. 3. April, 1926. New York City: The H. W. Wilson Company, 958–972, University-avenue. 1926.

Steam Turbines. By G. Belluzzo. Translated by Engineer-Captain A. G. Bremner, R.N. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 42s. net.

The Wapping Pumping Station of the London Hydraulic Power Co.

ON Monday last we visited, at the invitation of the London Hydraulic Power Company, the pumping station at Wapping, which has recently been reconstructed. This station has now, so we understand, a possible output in gallons which is equal to or greater than any other hydraulic pumping station in this country or elsewhere. The company's principal object in issuing invitations to inspect the plant was to afford its guests an opportunity for seeing in operation a particularly interesting pumping unit which has recently been put into service, but advantage was taken of the occasion to have on exhibition a number of other hydraulically-operated machines and apparatus to which we shall refer in due course.

Before going on to describe the new pumping unit, it will, perhaps, be of interest to our readers if we first of all make brief reference to the station itself. It stands alongside of, and takes its supply of water from the Shadwell Basin, which forms a portion of the London Docks. Coal barges can come alongside a wharf and from them the fuel is lifted by jib-crane and grab and deposited either into bunkers or into stock heaps. From the bunkers the coal descends through a shoot to a Babcock and Wilcox revolving measuring machine, which delivers it to a bucket conveyor, which in turn delivers it into the overhead bunkers of three Babcock and Wilcox boilers fitted with chain grate stokers. These boilers have an evaporative capacity of 25,500 lb. per hour under a steam pressure of 150 lb. per square inch, and increase the normal temperature of 366 deg. Fah. to 466 deg. Fah. The feed is provided by an hydraulically-operated plunger pump, there being a Weir feed pump and a duplicate injector as stand-bys. The feed water is heated in heaters, to which are led the drains of all the steam-operated engines in the station.



MATHER AND PLATT NINE-STAGE HYDRAULIC PUMP

The main hydraulic pumping machinery consists of :— (*a*) Six sets of vertical triple-expansion pumping engines of the well-known pattern of the Hydraulic Engineering Company, Ltd., of Chester. These engines have a combined capacity of 1500 gallons of water per minute, at 850 lb. per square inch pressure. They are automatically controlled in their speed of pumping by the rise and fall of hydraulic accumulators. (*b*) Two electrically-driven turbo-pumps, made by Mather and Platt, Ltd., of Manchester, each unit having a capacity of 500 gallons per minute at 850 lb. pressure. These pumping sets each comprise two pumps with the driving motor mounted between them on a common base. The motors operate on a 6000-volt three-phase 50-period circuit, and run at a speed of from 1480 to 1500 revolutions per minute, the voltage applied to the rotor being 490. (*c*) The new pumping unit, which comprises a steam turbine made by C. A. Parsons and Co., Ltd., of Newcastle-on-Tyne, which drives through single reduction gearing a Mather and Platt pump having a capacity of 1000 gallons of water per minute at a pressure of 850 lb. per square inch. We refer to this machine in detail later. The total capacity of the station is, as will have been realised from the foregoing, 3500 gallons per minute at 850 lb. per square inch pressure.

The water from the Shadwell Basin enters the site of the pumping station through a tunnel. It was formerly the practice of the company to filter the water by means of mechanical filters, but it was found that the area of the Shadwell Basin was so large that the heavier solids in suspension had very largely been deposited by the time the water reached the intake. Nowadays, therefore, it is merely passed through gratings to arrest floating solids and then through small mesh wire screens. The result is the production of what is, considering the circumstances, a wonderfully clear liquid which, we are able to say from examination, contains a remarkably small percentage of solids in suspension. From an intake well the water is pumped, ordinarily, by duplicate hydraulically-operated plunger pumps up to a cast iron tank of large capacity, which is carried on the roof of the building. This water is, before being pumped into the mains, passed through the various condensers, and is then again taken up to another tank on the roof into which it passes through further wire screens. It is from this second tank that the supply of water for the pressure pump is drawn. As the tank is on the roof of the building, the pumps are always primed and there is no suction lift. In passing we may say that, as a stand-by for the plunger pumps which force the water from the inlet well to the tank on the roof, there is a 24in. Pelton wheel, made by the Hydraulic Engineering Company, Ltd., which is driven off the main hydraulic supply mains, and is coupled to a Mather and Platt Medi-Vane pump. This Pelton wheel is capable of developing 35 brake horse-power when using 100 gallons of pressure water per minute; 30 brake horse-power when using 88 gallons; and 25 brake horse-power when using 75 gallons. The set can deliver 1000 gallons of water per minute at 65ft. head.

The pressure water from all the pumps passes into the mains through a recording meter, working on the Venturi principle. Connected to the mains at the station are two accumulators of large capacity.

Such, in brief outline, is the equipment of this station. A great deal more might be written regarding it, and of the prefect condition in which the machinery is kept, but at the moment we are chiefly concerned with the newest pumping unit which, as we have already said, is of considerable interest. It comprises, first of all, a turbine furnished with eleven sets of blading, two being of the Curtis type, four of the Rateau type, and five of the Parsons reaction type, the latter being used for the exhaust blading. It runs at a normal speed of 8000 revolutions, and it is capable, so we understand, of developing at that speed, rather over 800 horse-power with steam at 150 lb. per square inch superheated to 466 deg. Fah., and with a condenser vacuum of 28·6in.—the barometer being at 30in. The maximum diameter of the blading is 1ft. 10in., which, at 8000 revolutions per minute, means a peripheral speed of over 46,000ft. per minute. In operation its speed is regulated by means of an oil relay which operates the turbine throttle. The steam consumption of this turbine is said to be 10·83 lb. per brake horse-power hour. The bearings are forced lubricated, the oil supply being 28 gallons per minute at 5 lb. per square inch pressure, cooling being effected in a cooler, which is arranged in the basement below the turbine, and which requires 35 gallons of water per minute at 60 deg. Fah.

This turbine drives through single reduction Parsons gearing, which has a guaranteed transmission efficiency of 98½ per cent., a nine-stage Mather and Platt high-lift turbine, which runs at 1550 revolutions per minute, and has a full load efficiency of 78 per cent. It is of the makers' "Plurovane" type adapted for hydraulic service, and it is designed for a duty of 1000 gallons per minute at a pressure of 850 lb. per square inch. It is fitted with a disc balancing device which automatically takes care of the end thrust, while to relieve the automatic device at starting speeds and during heavy variations in load, a Michell thrust bearing is embodied in the outboard bearing, this bearing being furnished with oil circulation, the oil being cooled in a separate cooler that stands at the side of the machine.

Views of the pump and of the combined unit are given herewith and on page 638. During our visit it was operating on full load, and it was working with perfect smoothness and practically without noise. Although it is carried on a girder platform and not on a solid foundation, vibration was almost entirely absent. The plant has not yet been working long enough for the actual saving in operating costs which it has effected to have been accurately gauged—indeed, we understand that it has not even, as yet, undergone its official trials—but sufficient experience has already been had of it to warrant the opinion that the saving is very considerable.

In between the pump and the gearing there is a rope pulley which drives the condensate extraction pump and the circulating water pump at a speed of 1400 revolutions per minute. Both these machines are mounted on the same shaft and on the same bed-plate, which is arranged in the basement below the turbo-pump, the cotton driving ropes being carried through a hole in the floor. The extraction pump is designed to deal with 10·5 gallons of water per minute at 68ft. head under standard conditions against a vacuum of 29in. of mercury. It delivers the water to the feed heaters. The circulating pump is a split-casing, 8in. "Lonovane" machine, designed to deal with 1140 gallons per minute at 75ft. head. It has, we are informed, an efficiency of 72 per cent. Both pumps were supplied by Mather and Platt. The condenser, which is of the surface type and which was supplied by C. A. Parsons and Co., Ltd., has a cooling surface of 1200 square feet, and has a duty of 8620 lb. per hour, the condensate having a temperature of 90 deg. Cent. With the cooling water at 60 deg. Fah., 1100 gallons of circulating water per minute are required.

As was said above, there were various other things to be seen at this station besides the pumping machinery and accessories. For instance, forming part of the station equipment there are two hydraulically-operated ejectors for keeping the sumps in the basement free from water. One of these devices is non-automatic and the other automatic. The first, which operates with a hydraulic pressure of 750 lb. per square inch and a nozzle $^1/_{16}$in. diameter, is capable of raising 22 gallons of water per minute against a head of 12ft. 6in. Actually, 19·8 gallons of water are lifted with an expenditure of 2·2 gallons of pressure water, the ratio being 9 to 1. The automatic machine, which also operates at 750 lb. per square inch pressure, has a total delivery of 29·2 gallons of water per minute against a 12ft. 6in. head, 27·2 gallons per minute being raised with an expenditure of 3 gallons of pressure water, a ratio of 9·06 to 1. These ejectors, which were supplied by the Hydraulic Engineering Company, Ltd., are capable of dealing with gritty water at any temperature.

Among other things that we noticed was an injector fire hydrant, which is described as being "the equivalent of a fire hydrant, but automatically set in action and regulated by the opening or closing of any hydrant, sprinkler or drencher." The apparatus that was on view, and was seen in operation, had a delivery of 125 gallons of water per minute, including 43 gallons of pressure water—ratio, say, 2 to 1—at 80 lb. per square inch pressure. Then, too, there was a portable intensifier, also of the Chester firm's make, which is intended for testing or other purposes where a high pressure is required. When using 750 lb. per square inch working pressure this handy little machine, which is quite small, is capable of giving intensified pressure up to 6 tons per square inch. It was shown in operation in the company's yard. Close by it and also shown at work was a portable boiler tube-cleaning plant, composed of a 12in. diameter Pelton motor, made by the Hydraulic Engineering Company, Ltd., driving through a flexible shaft a centrifugal tube cleaner made by the Trident Company, Ltd., of Liverpool.

There was also an hydraulic bore head pump, as applied to deep-well pumps. Its delivery was given as being 50 gallons per minute at 70ft. head, using 4½ gallons of power water—ratio 10½ to 1. For this work it makes 15 strokes per minute, and has rams 1¾in. and 6in. in diameter, the stroke being 3ft. This machine also was of the Chester company's make.

We have only space just to mention some of the other things that were on view. They were :—(*a*) An oil pump to provide relay oil pressure; (*b*) a "Haarer" hydraulic lubricator; (*c*) a "Haarer" hydraulic control valve; (*d*) an hydraulic vacuum cleaner; and (*e*) a servo-motor for remote control valve gear. The exhibits, as a whole, gave, as they were intended to do, an excellent idea of the numerous directions in which hydraulic power can now be employed. Incidentally, we may remark that in various parts of the station we observed hydraulic engines employed for power purposes, such as driving shafting, &c.

THE largest oil engine ever installed by any of the gold mines of Ontario has been placed on the property of the Hollinger Consolidated Gold Mines, in the Porcupine goldfield. It is a 1200 horse-power Diesel engine, and will be used as an auxiliary power supply to the electric plant.

Incorporated Municipal Electrical Association.

No. I.

NOTWITHSTANDING that there was a feeling at one time that the thirty-first annual convention of the Incorporated Municipal Electrical Association at Glasgow might have to be postponed on account of the coal strike, the decision to carry it through as originally planned was thoroughly justified. There was an attendance of over 700 members, ladies and visitors, and to all outward appearances, at any rate, there might never have been such a thing as a coal strike. The Convention opened in the St. Andrews Halls on Tuesday, June 15th, when, after an official welcome by the Lord Provost, the presidential address was delivered by Mr. R. B. Mitchell, the Glasgow city electrical engineer. This is the third occasion on which the Convention has been held in Glasgow, the first visit taking place in 1901, when Mr. W. A. Chamen—now of the South Wales Electrical Power Distribution Company—was in Mr. Mitchell's position, and the second in 1910 when Mr. W. W. Lackie—now an Electricity Commissioner—occupied the presidential chair.

Mr. Mitchell in his presidential address struck out into rather an unusual line for such an occasion, because after a few general and non-committal remarks concerning the Government Electricity Bill, he gave some impressions of the conditions relating to electricity supply in America gathered during his visit there as one of the British delegates of the International Electro-technical Commission, which this year held its meetings in New York. Having visited ten power houses belonging to public utility undertakings, Mr. Mitchell did not see any generating units in use of less than 15,000 kilowatts, and they formed a very small proportion. For the most part, the capacity of the units was 35,000 kilowatts and upwards, and it is the intention in one case to install at an early date a unit of 100,000 kilowatts. Another important development was the introduction of the high-pressure turbo-alternator, taking steam from a separate boiler at about 1200 lb. pressure, and exhausting into the main steam range at the pressure of the main boilers. One plant of this description is in operation at the Weymouth power station, Boston, and another is in course of erection at Milwaukee, and Mr. Mitchell thinks that many supply plants in this country will have to follow this example in the near future. It may be, he said, a means of making our moderately efficient stations still more efficient without heavy capital expenditure and much scrapping of what may be still good and useful plant, it being estimated that under good conditions a saving of 7 per cent. may be obtained by the superposing of this high-pressure unit on the ordinary units in a power station.

Referring to pulverised fuel, Mr. Mitchell believes, as the result of what he saw in America, that we on this side of the Atlantic will be compelled to adopt this equipment as larger and larger boilers are demanded. Large capacity boilers need large stokers; the larger the stoker the weaker it is in proportion and the more complicated, and it is at this point, he remarked, that pulverised fuel becomes worthy of serious consideration.

The extent to which automatic boiler control has been developed in America was also commented upon and the view expressed that this question will, at an early date, receive the attention here that it deserves. As regards the cost of power stations in the United States, £25 per kilowatt is considered to be a quite moderate figure, though we in this country would consider it very much too high. At the same time, Mr. Mitchell gave an emphatic contradiction of the impression which exists in this country that our charges for electricity are higher than in America. In many cases, he said, they are much lower, and supply engineers in America even venture to suggest that charges in this country are too high, a view with which Mr. Mitchell expressed his disagreement.

Summing up, Mr. Mitchell stated that America, in many respects, but not all, is well ahead of us in things electrical. The Americans are thoroughly converted to the super-station idea; they believe in big plants and in interconnection over wide areas; they are going for maximum reliability and efficiency, the former always being placed first.

Following the presidential address, Mr. S. E. Britton—chief electrical engineer of Chester—read a paper on "Supplies to Outlying Districts." Mr. Britton is peculiarly fitted to deal with such a subject, by reason of the manner in which the rural areas around Chester have been developed in a quiet and unobtrusive manner under the very progressive policy initiated by him some years ago. The paper is divided into two parts. In the first, the author expresses himself in emphatic language on the legislative and administrative aspects of the electrical industry, and alleges that the methods adopted in constituting Joint Electricity Authorities and in dealing with applications for special orders under the 1919 Act have been most effective in encouraging super-parochialism. Commenting on the Government's Bill of this year and the endeavour made in Clause 30 to deal with the lopping of trees to facilitate the erection of overhead lines, Mr. Britton said that if this represents the mentality of those who drafted the Bill, then God help the electricity supply industry. The clause is certainly a splendid example of circumlocution.

The second portion of the paper urges that municipal authorities should at once make it a definite policy to supply the rural areas surrounding them, and should not, as they too often are, be driven to a policy of hesitation for the fear that any particular scheme will not pay. Figures are given showing capital costs, &c., and although it is definitely stated that few such schemes return an immediate profit, Mr. Britton, speaking from his own experience, said that they always did in the long run.

In the discussion, Mr. W. A. Turnbull—electrical engineer at Aylesbury—referred to the rural electrification scheme which his Council has in hand, and said that he was actually erecting the necessary overhead lines at cheaper rates than the figures suggested in Mr. Britton's paper. He had also got out a design for a galvanised 7/12 steel wire cable which could be erected for £295 per mile, and was capable of carrying 300 kilowatts a distance of 5 miles with 5 per cent. drop. He believed, however, that a copper-clad steel wire would be found the most economical proposition, and he hoped that such cable would soon be made in this country.

Mr. R. Borlase Matthews repeated many of the statements he made in connection with his recent paper on electricity in farming before the Institution of Electrical Engineers. He particularly emphasised the point that consumers in these rural areas would rather run the risk of interruption and variation in voltage than have no supply at all, and from this point of view he urged that the modifications of the low-voltage overhead line regulations which have been sent by the A.M.E.A. to the Commissioners still left the regulations too drastic. As another means of cheapening such supplies it was suggested that the farmers should provide the poles and labour, and do the erecting under the supervision of the supply authority. In such a case, the actual cost to the supply authority of the overhead line could be as low as £25 per mile. In other instances, the cost could be kept down to £120 or thereabouts by adopting similar methods.

Colonel W. A. Vignoles—electrical engineer at Grimsby—believed that it would be found preferable to use underground mains for developing outside areas because most of the houses would be on the main roads. Mr. R. A. Chattock—electrical engineer of Birmingham—strongly supported the main argument of the paper as against the scheme now being put forward by the Government, and at the same time put in a plea for greater consideration of direct-current supply, even in thickly populated residential districts. A number of other delegates strongly urged municipal authorities to show a more progressive spirit on the lines advocated by the paper, and to abandon the "will it pay" attitude before venturing in any way.

Mr. Britton replied that the keynote of the paper was that all such rural schemes paid in a short time, although not at once, and that it was far better for the larger municipal authorities to supply the surrounding areas to the economical limit of the capacity of their undertakings.

In the afternoon on Tuesday, June 15th, a visit was paid to the Dalmarnock power station of the Glasgow Corporation. These works were designed by Mr. W. W. Lackie, and the first section was practically completed before he left Glasgow on his appointment as an Electricity Commissioner. The original installation consisted of five turbo-alternators, each of 18,750 kilowatt capacity, or a total of 93,750 kilowatts in all. Under the supervision of Mr. Mitchell, the works are being extended, and two large machines, constructed by C. A. Parsons and Co., Ltd., have just been put into operation, making the total capacity at the present time 131,250 kilowatts.

Modern Flour Milling Machinery.*

By Lieut.-Colonel F. W. TURNER, of Ipswich, Member.

THE trade of flour milling is a very much more difficult problem in this country than in any other country in the world, owing to the fact that there is so little home-grown wheat, and what there is is so uncertain in quality, owing to the vagaries of the climate, that a very large percentage of wheat from other countries has to be used, and a thorough knowledge has to be obtained as to the special features of the various kinds of wheat, more especially with regard to strength and colour. A student of the milling trade must therefore learn what quality he can expect from the different imported wheats, so that, whatever wheats are available on the market and are cheapest at any particular time, he can purchase them and use them in the right proportion to maintain the quality of the flour which he turns out, and to suit the requirements of his customers. Our own supply of English-grown wheat is so small that it is almost negligible so far as the large port mills are concerned, but there are many country mills in wheat-growing districts which use as much as 80 per cent. of English wheat when there has been a good harvest, and seldom use less than 50 per cent.

It will be evident that for the same reason the miller must have accommodation for storing different kinds of wheat in larger or smaller quantities, and for this purpose a set of silos will generally be found adjoining the mill and in communication with it.

Pneumatic Intake Plant.—This type of intake plant has many advantages over the ordinary ship elevator, and only one disadvantage, which is, however, a rather serious one—it takes considerably more power per ton of grain taken in, ranging from 1·4 to 2 horse-power, against rather less than 0·5 horse-power for a ship elevator, both delivering to another elevator and band conveyor for feeding the silos.

From the water edge the pipe line of the pneumatic plant may pass direct into the warehouse, or if the premises are some distance away, may be laid either underground or overhead, but more usually, and unless there are any restrictions prohibiting it, it is carried on trestles overhead. The distance may be 300ft. or more, and the fact that this form of intake draws the grain all that distance by suction through a comparatively small pipe demonstrates very forcibly one of its great advantages over the elevator and conveyor system, which would mean a tower for carrying the elevator on the dockside and a substantial gantry from this tower to the mill building for carrying the band conveyor.

At the quayside the pipe line terminates with a flexible section and a nozzle which is buried in the grain to be lifted and is fitted with a contrivance to enable it to draw in air from above the grain, however deeply the nozzle may be immersed, this intake of air being absolutely necessary for maintaining the suction of grain. This nozzle may be moved about the ship or barge much more freely than the ship elevator boot, requiring much less manual labour for trimming and cleaning up.

The grain passes along the pipe until it reaches the receiving vessel and discharger in the position where it is desired to discharge the grain, and this is usually just above an elevator boot into which it drops and is elevated for delivery into silos.

The receiving vessel is just a break in the suction pipe which allows the air to expand, so that the grain automatically drops to the bottom of the vessel, from whence it is discharged by some form of air lock, which allows the grain to escape, but closes against any inlet of air. From this receiving vessel the air continues its journey towards the pump through a somewhat larger pipe and carrying with it a quantity of dust and grit, which with an ordinary elevator and conveyor would have remained in the wheat, and thus to a certain extent it takes a part in cleaning the wheat as well as conveying it. Before reaching the pump the air passes through dust collectors or filters, and enters the pump quite free from grit and dirt.

The wheat on its way from the intake to the bins or silos goes through a preliminary cleaning to take out large rubble, &c., which is done by means of a revolving reel or shaking separator, or both, and a strong aspiration. It is then stored in the storage bins, each different kind of wheat being kept separate, for the reason already explained, that the different wheats having different characteristics have to be very carefully mixed in order to get the right proportions and obtain a flour of the right strength and colour.

In order to obtain these correct proportions the different kinds of wheat are drawn off from the storage bins, by passing through a wheat measurer or mixer, one of which is fixed at the bottom of each bin, and all of which discharge on to one or more travelling band conveyors. These conveyors deliver into an elevator, which, in turn, discharges the mixed wheat into a further set of bins.

Wheat Measurer or Mixer.—There are several different types made and one very usual type consists of a series of pockets in a circular drum, which is mounted on a horizontal spindle. The spindle is made to revolve, and as each pocket comes round it is filled with wheat from the bin, which is thrown out to join the wheat from the other bins. The drum is revolved by means of a pawl working in a rack wheel, the pawl having a backward and forward motion given to it by a crank on a driving shaft. The stroke of the pawl is constant and continuous, but the work it does is controlled by a movable cover over the cogs in the rack wheel. This cover may be set by means of a handle and spring catch working on a graduated quadrant, so that the pawl engages with the cogs immediately on the commencement of its forward journey, moving the drum all the time, and this giving the full capacity of the measurer, or so that it does not engage until near the end of its journey, thus giving the minimum capacity, or it may be set at any intermediate point to give any capacity required within the range of the apparatus.

Cleaning and Conditioning.—From the mixed wheat bins the wheat is drawn off to be cleaned and conditioned, and in every well-equipped mill there is quite an elaborate set of machines for doing this, for although a preliminary cleaning has already taken place, there is still a lot of dirt and foreign matter to be removed. It is not all dirt by any means, but much of it is good stuff, such as barley and oats and other grain, which can be made good use of, and cockle and other small seeds.

Milling Separator.—The first machine in the wheat-cleaning plant is generally a milling separator which takes out all the impurities, both large and small, which can be easily separated by sieve or aspiration. It consists of inclined sieves, some with large holes or perforations for letting through the wheat and overtailing anything larger than wheat, and others with small holes for letting through sand and small seed and overtailing the wheat; as the wheat enters and leaves this machine, it is subjected to a strong aspiration by means of a fan which is either attached to the machine or connected to it by an exhaust trunk. The milling separator does not, however, take out the barley and oats, which will pass through the same screen as the larger wheat grains, nor cockle and other seeds which are about the same thickness as the smaller wheat, and to extract these special machines have to be employed.

Disc Separator.—The Carter disc separator was brought out by an American, Mr. C. W. Carter, in 1919. The principle of making the separation by means of little cells or indents, which was adopted in the earlier types of separating cylinders, is also the principle on which this machine works, but the indents, instead of being drilled on the inside of cylinders, are cast in flat cast iron discs, and on both sides, so that there is a very large number of

* The Institution of Mechanical Engineers—Ipswich meeting—condensed.

indents, roughly from 1500 to 4000 on each side of a disc. The discs vary in size from 15in. to 25in. in diameter. Several discs are fitted on a horizontal shaft at intervals of 2in. to 3in. placed in a specially shaped case into which grain is fed at one end. The shaft revolves and the discs run in the grain which travels slowly along amongst the discs being propelled by paddles. The revolving discs also keep the grain well on the move, so that every grain is bound to come into contact with the discs sooner or later before it reaches the end of the machine, which, even in the smallest size, is seldom fitted with less than eight discs for barley or twelve for cockle. The indents or cells in the discs are either just large enough to hold a wheat berry or just small enough not to carry it, and they are specially shaped so that the grain or seed will lie in it, whilst the disc revolves, until it reaches a certain position when the grain slides out. With the larger indents the wheat gets into the cells and is carried up, whilst longer grains, such as barley and oats, are unable to lie comfortably in the cells and are left behind. With the smaller indents, seeds and cockle, which are slightly smaller than wheat, are carried up and the wheat is left behind. Thus, with two machines, one fitted with discs containing large indents, and the other with discs containing small indents, the three necessary separations can be obtained, one of which consists of pure wheat. Combined machines are made fitted with one kind of disc at the head end, and the other at the tail end.

Every machine is fitted with a worm conveyor which runs along the side of the discs on the downward or delivery side, and this conveyor is fitted with trap doors, one to each disc, so that the liftings from the disc may be deposited, either into the conveyor if the trap door is open, or into the discharge spout beyond, if the trap door is closed. The grains which are deposited in the conveyor are thus carried back either for re-treatment by the same discs again, as in a barley machine, or, in the case of a cockle machine, for further searching out by the re-cockling discs, to make sure that no mistake is being made as to whether these grains are really wheat or whether they are actually barley or cockle.

Cockle Cylinder.—In addition to the introduction of this machine, there is an improvement to record in the design of cylinders as used for the extraction of cockle and small seeds from wheat. The cylinder itself is practically the same as the old pattern, consisting of a steel shell with innumerable indents entirely covering the inside surface, but instead of being mounted on a centre spindle it is carried on rolls by means of which the necessary revolving motion is imparted to it. This kind of drive leaves the interior of the cylinder entirely free for such appliances as may be best for dealing with the grain and obtaining the required results. The appliances which are used are mainly in the form of scrapers, which have the effect of keeping the grain well distributed over the surface of the cylinder and in a very thin layer, thus giving the cockle and seeds the best possible opportunity of finding the pockets, in which, when once found, they are carried up and delivered into a worm conveyor running down the centre of the cylinder, keeping them separate from the wheat which overtails from the cylinder.

This cylinder, which is called the "Kapak," runs at a very much higher speed than the old cylinders, 250 revolutions per minute against about 60, which gives it about four times the capacity.

Scourer.—After the separation of barley, oats and cockle on these machines, the wheat is run through a machine called a scourer, in which it is not only thoroughly scoured by revolving beaters in a well-ventilated casing, but is also subjected to a strong aspiration as it enters the machine and again as it leaves, thus removing the dust and dirt and blowing or drawing it away for collection in a dust collector.

Dust Collector.—The suction textile dust collector is still in general use. A somewhat similar machine is now available which is also fitted with close woven textile tubes into which the air is blown. These tubes act as a filter, the dust being retained in the tubes whilst the air comes through purified into the atmosphere. This is called the pressure type of collector, and is of much simpler construction than the suction type, the tubes being exposed to the air without any casing, and are only about 4in. in diameter against 8in. in the other type. They are connected to boxes at the top and bottom and may be almost any length, the top box being generally fixed to the joists of the floor above, whilst the bottom one stands on the floor. The air is blown into the top box and from there passes into the tubes, and through the material of which they are composed, whilst the dust, which is retained in the tubes, drops down into the bottom box, from whence it is automatically discharged. The tubes are induced to drop the dust which collects in them by means of a grid which is continually moving up and down them, and which slightly contracts the tubes as it moves, and loosens the dust.

Washing and Conditioning.—After the wheat leaves the scourer, it may be delivered direct to the clean wheat or mixing bins preparatory to going to the mill, or it may be sent to the washing and conditioning plant. It has become a generally recognised fact during recent years that whatever the nature of the wheat may be it is improved by immersion in water and treatment in a conditioner of some kind. It goes then first to the washer, or, as it is perhaps more correctly called, the stoner, its object being more the taking out of stones than actually washing the wheat.

Concentric Washer and Stoner.—There are various types of machines for carrying out this purpose. One, known as the concentric washer and stoner, will be described. It is shown in section in Fig. 1, which also demonstrates its method of working. No driving power is required for this machine, but the working is dependent upon an upward flow of water meeting a downward flow of wheat. The water is led by a pipe into the centre of an inverted open cone, above which is fixed an upright feed cone with an annular space of ¼in. to ½in. at the narrowest place between the two cones. The water surges up in this annular space and flows over the lip of the inverted cone, whilst the wheat rushing down the upright cone meets the surging water and is carried over the lip with it. The strength of the water flow is not sufficient to carry over anything of even slightly greater specific gravity than wheat. Therefore any little stone or even piece of brick or mud, which, being about the same size as the wheat, has escaped the previous cleaning machines, drops down through the water and is collected at the bottom of the inverted cone for removal through a weighted valve, as and when required. The wheat and water are received in an outer basin from the cones, and the wheat is rushed with a stream of water through a spout at the bottom and delivered either direct into a whizzer or first into a rinsing worm where a spray of clean water frees it from the muddy water coming from the washer. At the top of the outer basin of the washer are two openings, with sliding gates, through which the surface water can be run if desired, and other impurities which are of a lighter nature, such a chaff, dust, smut balls and even garlic, may be floated off by careful adjustment of the gates, thus eliminating some impurities which are the most difficult ones to separate by any other process.

The Whizzer.—The whizzer is what is called in certain other trades a hydro-extractor, its purpose being to throw off the water which clings to the wheat when it leaves the washer by means of centrifugal force. This is a very necessary machine, and a comparatively simple one, but a great deal of care has to be exercised in its design and construction as the action of the machine has a tendency to break or abrase the grains of wheat, which is a disastrous thing to do from a miller's point of view, and in some cases leads to the erection of costly and unsatisfactory so-called effluent recovery plants. The whizzers of the present day are invariably of the vertical type, in which the wheat enters at the bottom of the machine and is delivered at the top, being lifted by a series of inclined paddles or flights, which are attached to a vertical spindle, and revolve at a high speed within a cylinder made up of perforated steel covers. A recent improvement to this machine is an internal spray of water introduced by means of a hole drilled about half-way down the centre spindle and pipes leading therefrom with fine holes in them, from which the water is sprayed. This spray has three objects. (1) It washes down the perforated covers; (2) it gives the wheat a final clean rinsing; and (3) it enables the miller to add moisture to the wheat for conditioning purposes when a hard wheat is being used. On leaving the whizzer the wheat passes to the conditioning plant.

Conditioning Plant.—Conditioning has been the subject of much research work during the last ten years, and is still occupying a prominent place in the minds of both millers and milling engineers. Formerly conditioning meant simply drying. But later it was found that the wheat was in a better condition for milling if there was a certain amount of moisture in it, and that this moisture should permeate the whole grain and not be merely on or near the surface.

Hydroliser.—A new machine was therefore designed, which was called a hydroliser. It consists of a vertical column fitted with a number of radiators inside, heated by hot water or steam. The wheat travels down between and amongst these radiators, and is thoroughly heated, but the effect of this heating, which is done with very little ventilation, is to induce the moisture which was more or less on the surface to permeate equally throughout the grain. This heating section is followed by a cooling section, either immediately or after the grain has lain for a short interval in a bin or other receptacle, and in this cooling section the wheat is subjected to a cold blast of air, which has the effect of toughening the bran and retaining the moisture throughout the whole of the grain.

Aquafier.—Another form of conditioner is called the aquafier, and consists of a series of spiral conveyors, each about 10ft. long, and fitted in a cast iron steam jacketed case. From the steam supply any desired degree of heat can be applied to these conveyors, and to the wheat, which is continually on the move inside them, and is not merely travelling from one end to the other, but being turned over all the time, so that every grain gets an equal share of the treatment.

In this machine the temperature may be varied by adjustment of the steam-reducing valve, the length of time the wheat is in the cylinder may be varied by altering

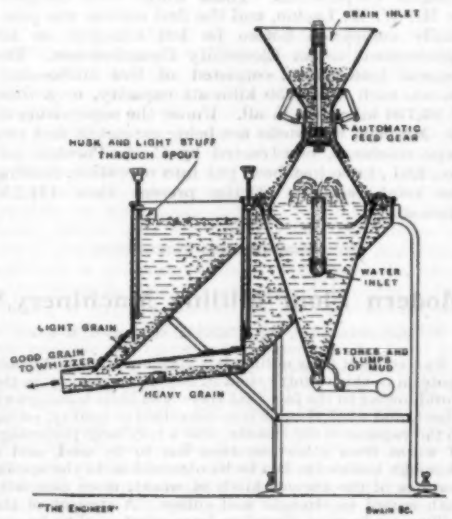


FIG. 1—CONCENTRIC GRAIN WASHER AND STONER

the speed of the drive, and moisture may be added to any desired extent, making it an ideal machine for the somewhat intricate business of conditioning wheats which come from all parts of the world, and have such varying characteristics.

Revolving Conditioner.—For drying and conditioning damp English wheats a machine which is in very general use is that shown in Fig. 2. It consists of an upright revolving cylinder mounted on a central spindle, and with two perforated casings with 1½in. space between them, which is filled with wheat. Into the interior of this cylinder by means of an air inlet at the top, hot air is blown, and by a similar inlet at the bottom, cold air, there being a partition about two-thirds of the way down dividing the hot air from the cold. These blasts of hot and cold air are blown through the wheat as it descends between the perforated casings, thoroughly drying it in the upper portion of the machine, and then cooling it to put it in a fit condition for milling.

The discharge of wheat from the bottom of the machine is automatically controlled by the amount in the feed hopper, so that the machine is always kept full of wheat. The length of time that the wheat is in the machine is regulated by increasing or diminishing the feed to it, which is done according to the condition of the wheat and whether it requires a long or short spell of treatment. This machine with cold air only blowing through it can also be used as a cooler following the aquafier.

Final Cleaning.—After passing through the cooling section of the conditioner the wheat is deposited in the

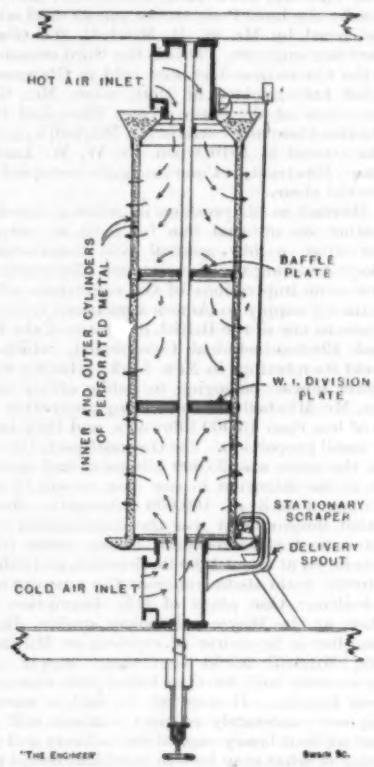


FIG. 2—REVOLVING GRAIN CONDITIONER

grinding bin ready for grinding. Before, however, it actually goes to the roller mills, it is customary to pass it through a brush machine to give it a final polish and aspiration, or, better still, through a machine called a planscourer, which has a slight scouring action and brings the wheat to a more complete state of cleanliness than the brush machine. The planscourer is arranged on the plansifter system, described in full later, but in place of sieves the trays are covered with emery against which the wheat is scoured as it proceeds. The last trays are perforated for taking out small seeds and dust, and the wheat is subjected to a strong aspiration as it leaves the machine. It then passes over a magnetic separator to remove any bolt, screw or other piece of iron or steel which may have become mingled with the wheat, and, finally, a record is taken of its weight on an automatic weighing machine to enable comparisons to be made between the dirty wheat which passed through the automatic weigher at the intake and the clean wheat going to the mill, and between the clean wheat going to the first break and the products sacked off at the tail of the mill. The record of the first part of the journey will probably show an average loss of about 1½ per cent. in the cleaning, although a large proportion of this will be screenings, which are of considerable value in themselves.

(To be concluded.)

THE JUBILEE OF THE TELEPHONE, 1926.

IN connection with the fiftieth anniversary of the telephone, the following arrangements, to take place on Thursday, June 24th, 1926, have been made by the Institution of Electrical Engineers:—

A luncheon will be held at the Hotel Cecil, Strand, W.C. 2, at 1.30 p.m., being preceded by a reception at 1 p.m. The presence of ladies will be welcome. At 2.30 p.m. a lecture on "The History and Development of the Telephone" will be delivered by Sir Oliver Lodge, F.R.S., honorary member, in the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2. The lecture will be preceded by the presentation, at 3.15 p.m., of the Faraday Medal to Colonel R. E. B. Crompton, C.B., past-president and honorary member of the Institution.

The annual conversazione of the Institution will be held at the Science Museum, South Kensington, London, S.W., at 8.30 p.m. Arrangements have been made for a special exhibition on this occasion of telephone apparatus of historical interest.

THE old salt works and grounds at Wheelock and Malkins Bank, near Sandbach, which are said to have been in existence more than a century, have been closed.

Railway Matters.

THE present congestion in the streets has apparently again aroused interest in the scheme of the late Mr. A. W. Gattie for a central goods clearing station for London. A deputation on June 11th waited upon Sir Henry Maybury, Director-General of Roads, in the Ministry of Transport, who promised to go into the matter, with special reference to the London traffic problem.

AT a recent meeting of the Illuminating Engineering Society, Mr. A. Cunnington, the lighting engineer of the Southern Railway, alluded to the effect on the vision of drivers passing out of the darkness of tunnels into brilliantly lighted stations. He suggested that some method of partially illuminating the interior of the tunnel, thus relieving the contrasts, would be useful.

THERE were two serious accidents on British overseas railways last week. On Wednesday a train was derailed at Salt River, near Capetown, and the rear coaches struck an overbridge. Fifteen passengers were killed and two died later from their injuries. On the following day a trestle bridge near Aberdeen, in New South Wales, collapsed as the Sydney-Brisbane express was passing over it. Five passengers were killed.

ACCORDING to a report in the *Japan Chronicle*, the Korean Railway Bureau, for the solace of railway employees and their families in remote districts, is contemplating running an entertainment train. The train will be manned by Japanese, Korean, Chinese, and Russian magicians, jugglers, dancers, &c., and a kinema party, and is to stop at each station and give performances in the train for the benefit of the lonely railway employees and their families.

THE main departure line at King's Cross is No. 10 road; east thereof and in the middle of the station is another departure road which is No. 5. Between those two roads there are four sidings which it has now been decided to remove, and on the space so set free to erect a platform 945ft. long, which will be served by a platform road on each side. Siding accommodation to substitute that thus displaced will be provided at Holloway. The whole scheme will cost about £9000.

THERE is a movement in Italy, which has Signor Mussolini's support, for the construction of another Alpine tunnel. It is proposed to make a tunnel under the Stelvio Pass, which would link up East Central Europe with Milan and Genoa, and shorten, by 100 miles, the distance between Munich and Turin and Milan and, by 120 miles, that between Munich and Genoa. It would also join West Central Europe with Venice and Trieste, and shorten, by 135 miles, the journey between Frankfort and Venice.

IN the King's Bench Division, on the 2nd inst., another case of a claim made on a workman's ticket arising out of the Milton Halt, Gravesend, collision of August 21st, 1922, was dismissed. The user of such a ticket is not entitled to more than £100 damages in the event of personal injuries. The man in question sought for more, but failed. A point that does not appear to have been discussed was that the ticket was bought and paid for by the Roads Department of the Ministry of Transport, and presumably it could be argued that the man was compelled to accept the limited conditions.

ADDRESSING the Rotary Club at York a fortnight ago, Mr. Jenkin Jones, the general superintendent of the North-Eastern area of the London and North-Eastern Railway, said that when some months ago the traders at Hull alleged that it took seven days to move traffic from Hull to the West Riding, a census for a week was taken—which happened to be the busiest week after two years—as to the average time of transit for all the wagons between Hull and various points in the Midlands, the West Riding and Lancashire. It was then found that the average time from leaving the loading point to arriving at destination was 24¼ hours. Later, an investigation was made as to the length of time every wagon, from all points in the country, took to reach the North-Eastern area. There were 8500 wagons concerned, and the average time was 1¼ days: 5000 reached their destination on the day after dispatch and 2000 on the second day.

IN this column of our issue of April 30th it was stated that counsel for the railway companies had told the Railway Rates Tribunal that he hoped that the proceedings would make such progress that the companies could issue their new schedule of charges in sufficient time for the "appointed day" to be January 1st, 1927. When the Tribunal resumed its sittings on the 7th inst., counsel said, however, that, owing to the strike, that course would not be practicable, but he thought the "appointed day" might be May 1st, 1927. The fixing of a date during the currency of the railway financial year would be objectionable, but a delay until January 1st, 1928, would be worse. Mr. Macmillan said that in anticipation of the fixing of the new charges the companies proposed to increase exceptional rates by between 50–60 per cent. above the pre-war rates, but as they had been advised that they could not legally do so, it was intended to make an increase in one instance and take it as a test case to the Railway and Canal Commission.

WHEN the Electricity Bill was before the Standing Committee on June 10th, an amendment was moved that railway generating stations, operated by railway companies, should not, without the consent of their owners, be included in the scheme as selected stations. The Attorney-General said, in reply, that the requirements of the railways differed from others, in that the railways used direct current. He thought the request of the companies, that they should be specifically excluded, was not an unreasonable one. The Government hoped that the railways might see their way later to use current more extensively, and also to use current supplied by the scheme. There was nothing to prevent that, but at present the companies were working with a different kind of current, and it was not anticipated that they would immediately come into the scheme. So long as they remained out they would want to operate their own generating stations, which would not fit in with the frequency in the scheme. The amendment was agreed to and, by another amendment, the same concession was given to canal, dock, and harbour undertakings.

Notes and Memoranda.

SOME tests carried out in America on the strength of lime mortar brickwork show that a compressive deformation of $^1/_{25}$in. per foot of height required a load of 70 lb. per square inch at an age of one day and a load of 180 lb. at twenty-eight days.

ACCORDING to the *Industrial Australian*, Mr. A. G. Black, of Melbourne, has succeeded in producing a satisfactory briquette from the local brown coal. It has a calorific value of 13,520 B.Th.U., and represents about 50 per cent. of the raw material.

IT is claimed that a record in mine shaft sinking was secured recently by the Randfontein gold mine in South Africa, when 332ft. of shaft, 23ft. 6in. in diameter, was sunk in thirty-one days. An average of 420 tons of rock was hoisted out of the shaft each day.

A FACTOR of increasing importance for the Swedish pulp industry is the recent increase in the manufacture of artificial silk. During 1925 some 40,000 tons, or one-third of the world's total demand for raw material for the artificial silk industry, was supplied by Sweden.

A SHORT article in the *Engineering News-Record* describes how concrete was mixed for a large contract in Baltimore. The cement and water were mixed by being circulated through a centrifugal pump and the resulting slurry was then mixed with the aggregate. A great saving in time is claimed to have been effected without sacrifice of strength.

BUILDING and construction contracts entered into in Canada during the month of May exceeded in value those of any previous month on record, having a total of 57,139,700 dollars. This figure is 53 per cent. in excess of that of April, which was 37,291,600 dollars, and 67 per cent. ahead of the total for May, 1925, which amounted to 34,052,100 dollars.

GLYCERINE is, according to the *Chemical Trade Journal*, largely employed in Germany as a lubricant in hydraulic presses and similar machinery. The material has doubtless many advantages, but experience has shown that if the surfaces lubricated be of different metals, actual contact between the metals should be avoided if the danger of corrosion is to be minimised.

A NEW carbon monoxide recorder has been developed by the American Bureau of Mines for use in the detection of poisonous gases in tunnels. In it thermo-couples are used to measure the increased temperature of the gases when the carbon monoxide and oxygen react chemically in the presence of a catalyst. The apparatus is said to be extremely sensitive.

THE *Iron Trade Review* refers to the passing of the last rolling mill in the United States dating back to Revolutionary days. This mill is situated at the Stanley Works plant at Bridgewater, Mass., and is about to be dismantled. The Bridgewater mill, said to be the only one of its kind in the world to-day, was founded in 1784, and was active in the manufacture of cannon for the war of 1812.

IT is claimed that a reinforced concrete chimney recently built at Trail, British Columbia, is the tallest of its kind on the American continent. It is 400ft. high by 21ft. diameter inside at the top. The walls are 2ft. 6in. thick at the bottom and 6in. at the top. The draught produced by the chimney, which is used by a smelting works, is 1¼in. W.G., with an average flue temperature of 340 deg. F.

SOME investigations carried out by the Linde Air Products Company tend to show that, in the case of rotary lime burning kilns with riveted joints, movements of the joints between the plates towards the centre of the length are twice the elastic stretch of the material. With welded joints, however, this trouble is eliminated, and it is suggested that the shell might be consequently lightened, with a saving of about 8 tons of metal in a kiln 125ft. long by 8ft. diameter.

ACCORDING to latest accounts, the Village Deep Mine, Transvaal, is now the deepest in the world, the workings extending to a vertical depth of 7062ft. Working at these great depths necessitates the very closest attention to the ventilation of the workings. At 7000ft. deep the rock temperature is approximately 96·1 deg. Fah., and large volumes of air must, therefore, be circulated underground to maintain satisfactory conditions. In the development ends a considerable measure of success in cooling the working places has been attained by placing large blocks of ice in the ventilating pipe through which air is blown into the development ends. The problem of cooling the stopes is a more difficult matter, but it is having careful attention.

THE production of pigments ranging in shade from orange to purplish-red by mixing cadmium sulphide with cadmium selenide, has, says the *Chemical Trade Journal*, been known for a considerable time. These pigments have always been high priced, but according to a French patent (No. 584,264, of November 17th, 1924) they can be made more cheaply by the following process:—Cadmium oxide or cadmium carbonate is heated with sulphur and selenium to a temperature approaching dull redness. When the evolution of vapours has ceased the melt is allowed to cool. The greater the proportion of selenium in the mixture the redder is the shade of the finished pigment. In an example cited in the patent, 25 parts of cadmium carbonate are heated with 3 to 5 parts of sulphur and 3 to 5 parts of selenium.

A FORM of cast iron recently brought but in the United States has, according to the *Iron and Coal Trades Review*, an average ultimate tensile strength of 50,000 lb. per square inch, as compared with 20,000 lb. to 25,000 lb. per square inch for ordinary grey iron. The yield point is within 2 per cent. of the ultimate strength. Transverse tests showed a deflection of 0·03in. to 0·05in. at a load of 2500 lb., and 0·10in. to 0·14in. at the loads at which the bars broke, which ranged from 5500 lb. to 6600 lb. at centre. Torsion tests showed an ultimate twisting moment of 9600 to 10,260 in.-lb. for test bars ranging from 1·052in. to 1·063in. diameter. In compression, Meehanite, it is stated, will stand 125,000 lb. per square inch. The Brinell hardness of cast iron varies from 140 for soft machinery castings to 600 Brinell for white irons. The average Brinell hardness of the new iron is 258, but it may be readily machined, behaving more like steel than cast iron.

Miscellanea.

IT has been decided to operate a trackless tramway system in the French concession at Shanghai.

THE output of sulphuric acid in France during 1925 was 1,610,000 tons, as compared with 1,550,000 tons in 1924.

A LARGE factory is being erected at Rostow on the river Don in Russia for the manufacture of zinc oxide. The capacity of the plant is to be 8000 tons a year.

IT is proposed to provide a proper water supply to Yangchow, Kiangsu, China, and a sum of some £15,000 has already been subscribed for preliminary purposes.

A COMPANY with a capital of about £2,000,000 has been organised in Shanghai for the construction at Hankow, China, of motor cars designed on American principles.

THE British Columbia Electric Company proposes to expend 25,000,000 dollars during the next three years. The most important items of the scheme are hydro-electric power plants.

IT is reported that the ore reserves of the Lucett antimony mine, near Laval, Brittany, which has been one of the largest producers of the metal in the world, will be exhausted in another three years.

IT is claimed that a record for gliding with an engineless two-seater aeroplane has been set up by the German aviator F. Schultz, who kept his machine aloft from 4.52 a.m. to 2.13 p.m., or for 9 h. 21 min.

THE great 60,000-ton floating dock of the Southern Railway Company has been temporarily moved from its station on account of the bed silting up. The operation occupied several hours, and required the assistance of eight tugs.

AN account in the *South African Mining and Engineering Journal* describes a vein of gold-bearing quartz containing up to 400 dwt. of the precious metal per ton. The vein is in the Gwanda district of Rhodesia, and is apparently of considerable extent.

A SYSTEM of electric tramways is being laid down in Harbin, but will not be completed until next year. In the interval the franchise of the existing motor omnibus service is being extended for another year. It is noteworthy that the tramway material is being supplied by Germany.

A FACTORY for the manufacture of soda powder is to be put up at Pulantien, Kwangtung, China, at a cost of some £600,000. The yearly output is estimated at 40,000 tons. Among the other projected factories in China of which we have recent news, there are a paper works at Wuchow, to cost £15,000, and an artificial silk factory at Tiehsi, Manchuria, on which £200,000 is to be expended.

THE Provincial Governments of Ontario and Quebec have arranged for a joint survey of the Ottawa River to ascertain its power possibility, and to agree upon a plan of development which will divide the resources equally between the two provinces. The Ontario Government has appointed Thomas H. Hogg, hydraulic engineer, as its representative, and as soon as the Quebec Government appoints its representative the work will proceed without delay.

THE Uxbridge Rural District Council has recently received sanction to a loan of £74,353, it being the first section of a scheme of £130,000 for the drainage of the parishes of Ickenham, Hillingdon and Harefield. The scheme is in the area of the Thames Conservancy and provides for outfall and branch sewers and sewage disposal works, where the sewage will be pumped for settlement and purification treatment on bacterial filter beds, the effluent discharging into the Yeading Brook.

SUCCESSFUL trials have been made at the Atlas-Diesel Works, Sweden, of a large marine oil engine to be fitted into the motor tanker Sommerstad, which the Lindholmen Shipyard at Gothenburg is constructing for Klaveness and Co., Oslo. The tanker will have a deadweight capacity of some 8000 tons and a speed of about 11½ knots. The engine, which is probably the largest ever constructed in Sweden, is designed to develop 2700 indicated horse-power in six cyinders at 100 revolutions per minute.

ARRANGEMENTS have, according to the *Chemical Trade Journal*, been completed to provide for the utilisation of a laboratory in the School of Chemistry of Melbourne University, Australia, by the Electrolytic Zinc Company, Ltd. Dr. J. Wark has been appointed by the company to carry on research into electrolytic processes as assistant to the consulting chemist of the Electrolytic Zinc Company, Sir David Orme Masson, formerly Professor of Chemistry at the University of Melbourne. The company is fitting up a room in the Chemistry School, and at the end of three years all apparatus and equipment used will be handed over to the University.

A BILL incorporating the Canadian Dexter P. Cooper Company and authorising it to develop power from the tides of Passanaquoddy Bay in New Brunswick has passed the Canadian House of Commons, and now goes to the Senate. The scheme provides for the development of 500,000 to 700,000 horse-power at a cost of between 75,000,000 and 100,000,000 dollars. A series of dams with navigation facilities are to be constructed between the islands from the coast of Maine to the coast of New Brunswick, and the power-house will be situated on the American side of the boundary. The company is authorised to issue bonds to the amount of 10,000,000 dollars.

THE Secretary for Mines announces that the report of the judges appointed to adjudicate on the electric storage battery locomotive competition for a prize of £1000, offered by Mr. Charles Markham, of Ringwood Hall, Chesterfield, has been published. The winning design, as we have already announced, was entered by Joseph Booth and Brothers, Ltd., Union Foundry and Ironworks, Rodley, Leeds. An outline is given in the report of the technical requirements governing the competition, the tests applied and a general description of the winning locomotive. The report, price 1s. 3d., may be purchased through any bookseller or directly from H.M. Stationery Office.

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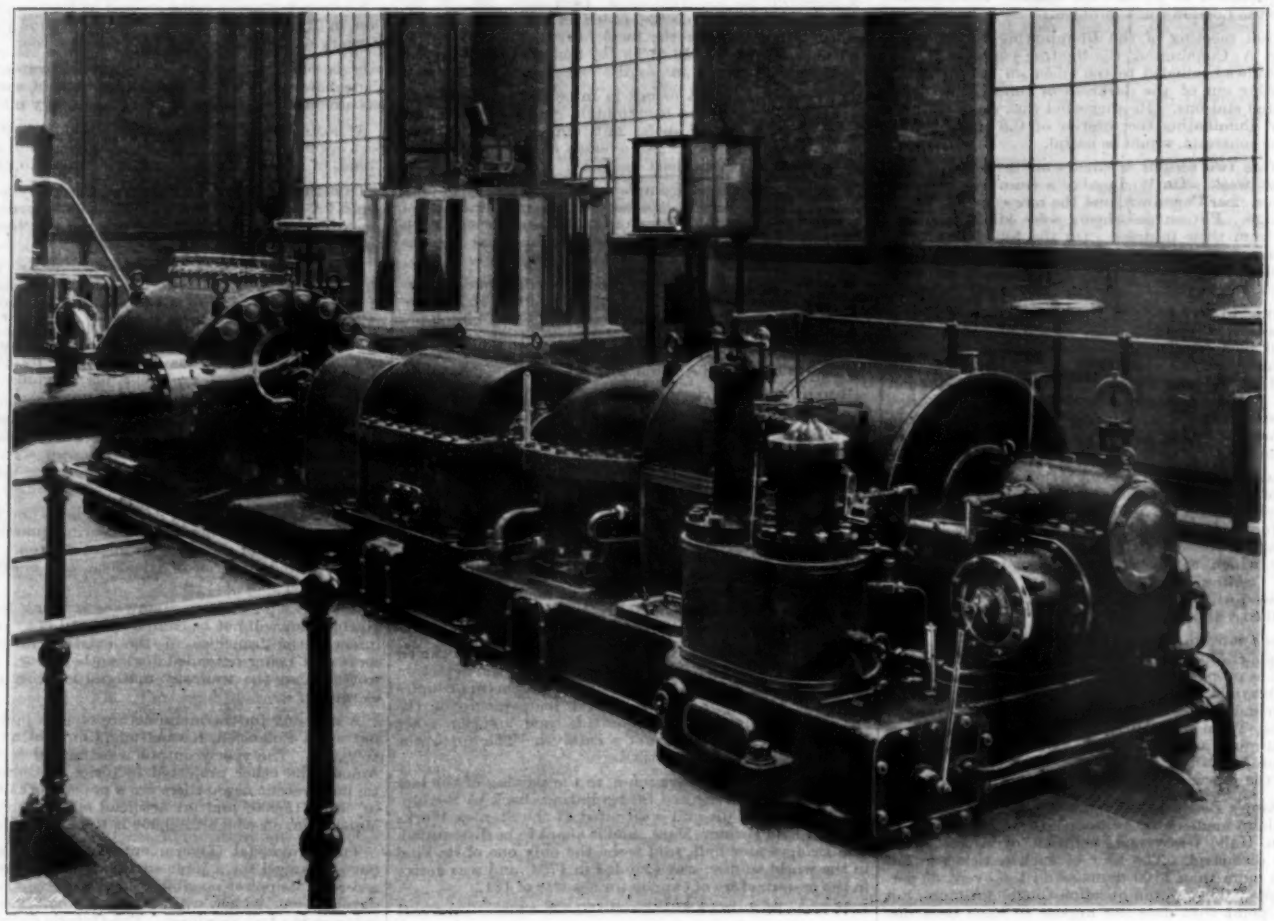

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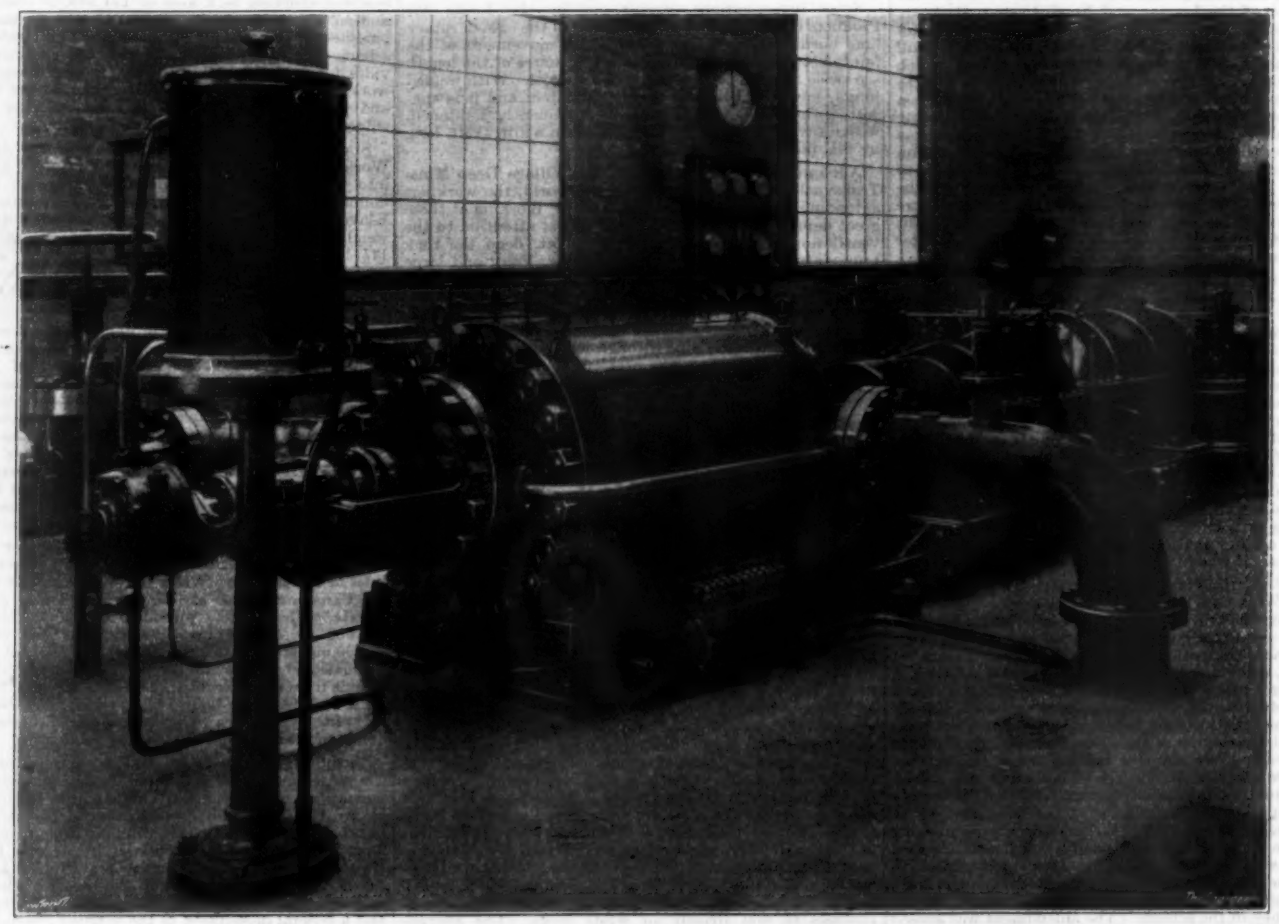

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THE ENGINEER.

JUNE 18, 1926.

Rebuilding the German Navy.

THE publication of the German Navy Estimates for 1926–27, coinciding with news of the construction of warships in German yards, has directed attention to the gradual but steady progress that is being made towards restoring that naval power which seemed so recently to be shattered beyond repair. Judging from the relatively large sums which the Reichstag votes year after year for naval purposes, the will to sea power still persists in Germany. The desire to possess an efficient fleet, even though it be of modest dimensions, is natural enough in the circumstances in which Germany finds herself to-day. She has already resumed her former place as one of the great shipowning and trading communities, and a certain measure of naval protection for these important maritime interests is not merely desirable but essential. Nationalist propaganda has no doubt played some part in keeping alive the spirit of enthusiasm for the fleet, but we are inclined to think the more sober elements in Germany are supporting the movement from motives less open to suspicion. Be that as it may, her efforts to build up a new fleet need cause no apprehension on this side of the North Sea so long as the restrictions imposed by the Versailles Treaty remain effective. The process of reconstruction may be said to have begun in March, 1919, when a Bill for the foundation of a "provisional Reichs-Marine" was passed by the National Assembly at Weimar after a speech by Herr Noske, the Min'ster of Defence, who declared that a new navy was needed "to safeguard the transport of foodstuffs, to remove mines, and to protect the fisheries." Later in the same month the German Admiralty was reconstituted, the officer in charge being given a seat in the Cabinet, though only in an advisory capacity. This important step has had the effect of grouping all departments of the service under one head, a system which never obtained under the Imperial *régime*. In October, 1920, the Reichstag appropriated 25,000,000 marks for the building of a new cruiser, which has since been completed and placed in commission under the name of Emden, thus commemorating the raider which caused such heavy loss to Allied shipping in the war. In 1921 the first two German battleships were placed in full commission. They were, of course, old pre-Dreadnoughts, of limited fighting value. Other ships have since come into service, and by next year the active fleet will probably have attained the full strength authorised under the Versailles Treaty, viz., six battleships, six cruisers, and twenty-four torpedo craft. The *personnel* now consists of nearly 14,000 officers and men, the former serving for twenty-five years and the latter for twelve years. There is every reason to believe that the long-service volunteers are more competent and trustworthy than the three-year conscripts by whom the old Imperial Navy was manned. The proportion of commissioned and warrant officers is somewhat large, representing as it does about 18 per cent. of the total.

In 1922 and subsequent years the Reichstag adopted Navy Estimates which show a progressive increase, culminating this year in a vote of £10,165,000, an increase of £2,410,000 over the Estimates for 1925. It is interesting to learn that this relatively large sum was voted after a very brief discussion. In the current Estimates new ships and armaments account for no less than £2,705,000, an increase of 33.5 per cent. on last year's vote. A second cruiser was begun in 1925, and this year two further ships of the same type are to be laid down. Provision has been made, so far, for four cruisers, each to cost £1,420,000; twelve destroyers at £270,000 apiece, and one experimental torpedo-boat at £100,000. In all, therefore, a sum exceeding £9,000,000 has been set aside for new construction. Further vessels are projected. Substantial grants have also been made for reconditioning old ships, for new guns, torpedoes, and mines, and for carrying out experiments. The exact amount which Germany has spent on her navy from 1919 to the current year is not easy to determine, but is believed to exceed £50,000,000. The terms of the Peace Treaty require Germany to limit the displacement of her future armoured ships to 10,000 tons, of cruisers to 6000, and of destroyers to 800 tons; but in spite of these restrictions, German designers appear to be turning out some very efficient ships. While the new Emden, of 6000 tons, is slower by 5½ knots than our 33-knot "E" class cruisers of 7600 tons, she has a heavier armament and a larger steaming radius. Further, the new German destroyer Moewe, though displacing only 773 tons, is designed for a speed of 33 knots, and mounts four 4.1in. guns, besides four torpedo tubes. Building activity is confined for the present to cruisers and destroyers, but the question of replacing two of the oldest battleships is now under consideration, and various tentative designs for an armoured vessel of 10,000 tons have been prepared. Great speed is not regarded as imperative in a ship of this type, the primary function of which would be coast defence. Most of the weight would therefore be available for armament and protection, and it should be possible to provide four, if not six, heavy guns, together with adequate defence over vital parts. Such a vessel would necessarily be inferior in every respect to a Dreadnought, but it would represent a "Machtfactor" of some considerable weight in the northern seas of Europe, where, apart from the two or three dilapidated Dreadnoughts under the Soviet flag, no capital ships above the coast-defence category are to be met with. The question to be resolved, however, is whether a small battleship, costing about £3,000,000, offers a better investment from the point of view of coast defence than a flotilla of new destroyers or a flock of high-speed motor torpedo craft, the designs for which have also been prepared. The final decision rests with the naval staff, and we shall probably learn what it is when the next Estimates come out.

In the meantime, the "condition of absolute impotence" to which, according to certain German writers, their navy has been condemned is by no means apparent to foreign observers. That the small fleet now in service is overshadowed by the major navies is certainly true. But Germany, for obvious reasons, does not yet aspire to regain the commanding position at sea which she held before the war. Even her most ardent patriots are constrained to admit that their country's naval policy must be guided for many years to come solely by considerations of self-defence. Now, without venturing into the realm of politics, every onlooker perceives that German's immediate problem of naval defence is centred in the Baltic. If her northern maritime frontier is adequately guarded, she may feel reasonably safe from external aggression. When the naval resources of the various Baltic States are compared, the superiority of the German Fleet in all the elements that count is found to be very marked. Sensational rumours of Russian naval activity are heard from time to time, but still await confirmation. News from every reliable source is such as to suggest that the Russian Fleet remains miserably defective in *personnel* and material. Much is made of the fact that it contains two Dreadnoughts; but these vessels, although seaworthy, would require to have their propelling machinery entirely renewed before

they could approach their legend speed. Their best pace at present is about 16 knots. Two, or perhaps three, of the cruisers are effective, but it is to be doubted whether more than a dozen other vessels, including submarines, could put to sea at short notice. There is admittedly a woeful shortage of technical equipment, the fire-control system is obsolete, and even the ammunition for the guns is the residue of war stocks. The dockyards are unable to execute heavy repairs, owing to the deterioration of plant and the dearth of skilled workmen. As for the *personnel* of the fleet, probably the less said about it the better. The Soviet authorities are now inviting elderly officers of the old Tsarist navy to assist in rendering the fleet efficient, a task which appears to have defied every effort up to the present. In view of these facts, there can be no serious question as to the superiority of the German Navy over the heterogeneous collection of ill-found and badly manned ships which comprise the Russian Baltic Fleet. If the German vessels are old, they are in fairly good repair, they have trained and disciplined complements, and they are periodically exercised at sea. In short, the Germany Navy of to-day is a relatively strong and efficient force, which should be capable of holding its own against any prospective opponent. Its further development on the material side is assured by the substantial programme of new construction now in hand.

Education and the Employee.

WE commend to the attention of our readers the paper by Mr. F. W. Goodenough which was presented last week at the meeting of the Association for Education in Industry and Commerce in Birmingham. Part of this paper we reprint on page 644 of this issue. The remainder of it is concerned with the details of the educational schemes employed in the gas industry; unfortunately, the limitation of space obliges us to omit it, but, fortunately, the general principles which Mr. Goodenough propounds are of more general interest than the particular method of applying them which he describes. Diverse views exist as to the education of employees. On the one side we have, at the extreme end, those who believe that the education of workpeople is not only waste of time and money, but is positively harmful because it creates unrest; at the other side, equally at the extreme end, we have those who would set up escalators between the Board School and the University, and give all the people the same education. Mr. Goodenough takes a rational position between the two. His idea of education is that it should be something which will make the employee more useful to himself and more useful to his employer. That may be regarded as the utilitarian side. To it he adds that education enables the employee to make more intelligent use of his leisure—a very important point upon which we ourselves have from time to time insisted.

When Mr. Goodenough places in the very first line of his paper the question "Does the education of employees pay?" he takes a dangerous step. Not because he has any hesitation in answering that question, or because his answer is likely to be challenged. His experience is too long to leave an opening for doubt about the value of his opinion. No; the danger lies in the possibility that by this clear declaration he may undo what he has begun, and fail to do what he has set his heart upon doing. There is a baffling type of mind which will at once rise in resentment against the thought, implied in Mr. Goodenough's question, that education—or, for that matter, anything else save technical training—should make an employee more useful to his employer. That type of mind is not peculiar to workpeople themselves; it may be found amongst "intellectuals" who are sometimes heard to sneer at any good action of employers which makes men better workmen. They want some vague absolute altruism which would do the workman good, we assume, without benefiting the industry at all. This is no fanciful picture. Over and over again it has been found that welfare schemes were actually opposed because the employees saw that the improvement of health, both of body and mind, which such schemes effected, would make them more valuable. The same kind of opposition to the premium bonus plan is quite commonly heard. There are men who will not have it, even though it benefits them, because it makes them more useful to their employers. They will accept it if every atom of the advantage is given to them; but they will not share it with the industry to which they belong. Mr. Goodenough, who is certainly acquainted with this attitude, would no doubt say that it is just one of those things which show the necessity of extending the education of employees. And we must agree with him, even whilst we have to acknowledge that some people of good education still take this narrow and stultifying attitude. Had we any sympathy with those who would withhold education from workpeople—which we have not—we should recognise that it is now too late in the day to make any alteration in that respect. Education must go on, and the best hope of removing the harm which in some respects it has wrought is to extend it so that, with expanding minds, the workpeople themselves may recognise the advantages which it brings to them not less than to the industry. Speaking from a long experience, Mr. Goodenough is able to say definitely that gas companies "have increased the maximum rates of pay of certain classes of officers in their service, and the annual increments of pay whereby the maximum rates are reached, because they have found they are getting more valuable employees as the result of their improved education and training. They have been able to promote to staff positions of substantial present value and good future prospects a higher proportion of lads entering their services from elementary schools than they could find worthy of promotion before their educational scheme came into operation." In the company with which he is associated—the Gas Light and Coke Company—Mr. Goodenough has, apparently, not met with the difficulty to which we have alluded. He has found the British workman "highly responsive to genuine efforts to aid him in his self-development and advancement . . . and, especially, to the knowledge that he can earn promotion through merit, and in no other way." The gas companies are perhaps exceptional in this respect. Merit is not universally encouraged in trades union circles, and the desire to help industries is, all too often, not only lacking, but replaced by its opposite. Yet there always remains a percentage of employees—how big it is has been concealed by the open ballot—who do earnestly wish to make their way by merit and who rightly look upon education as a means towards that end. It is well that such men should be encouraged, and that such educational schemes for employees as that adopted by the gas companies should be supported.

There is another aspect of this business; perhaps a more important one. The progress of a particular firm and the well-being of the men that serve it must always take the second place in comparison with the community as a whole. Fortunately, in the case of gas companies certainly, and in most other cases probably, the two move forward together. The better the workpeople the better the product. The more educated the workpeople, the wider their interest in their own firm and in the development of the industry. Broadness of education brings with it a sense of responsibility and duty. Duty is a word which one dare hardly use in these advanced days when the only duty that many admit is duty to themselves. Yet in the long run, it is at the root of all education. "To make us know our duty and do it" run the familiar words of Froude's St. Andrew's address, "to make us upright in act and true in thought and word, is the aim of all instruction which deserves the name, the epitome of all purposes for which education exists. Duty changes, truth expands, one age cannot teach another, either the details of its obligations or the matter of its knowledge, but the principle of obligation is everlasting." Those words exale an atmosphere which has grown tenuous in recent years, the atmosphere of half a century ago, but as a definition of the real purpose of education, they cannot be surpassed. It is delightful to hear from Mr. Goodenough that the educational system of the gas industry is achieving results which would have won Froude's commendation.

Conversazione of the Institution of Civil Engineers.

ON Wednesday last, the 16th inst., the conversazione of the Institution of Civil Engineers was held at the house of the Institution, Great George-street, Westminster, which was charmingly decorated with flowers and presented a very festive appearance. The large gathering of members and guests was received in the Great Hall by the president, Sir William H. Ellis, who was assisted by Lady Ellis and the Council. During the evening, which throughout was a most enjoyable one, a programme of music was provided by the Central Band of H.M. Royal Air Force, whilst added pleasure was given by the violin solos of Miss Margaret Fairless and the monologues and character studies of Mr. Bransby Williams. There were also three lectures on engineering subjects, one of which was given by Mr. G. M. Clarke, M. Inst. C.E., on "Modern Mining in South Africa"; one by Mr. Victor Bayley, M. Inst. C.E., on "An Engineer's Experiences with the Kyber Tribes"; and one by Sir Murdoch MacDonald, M. Inst. C.E., on "The Engineering Development of the Sudan, especially in Regard to Cotton Growing." As on previous occasions, the museum of the Institution, which contains a collection of specimens illustrating the deterioration of structures exposed to sea action, was open to view, and in the Library an exhibition of engineering models and scientific apparatus was arranged.

In what follows, brief reference will be made to some of the exhibits, which we noted covered a wide range of interest and application. Among those which dealt with buildings and building materials, we may perhaps single out the fine model shown by Dr. Oscar Faber, representing the Bank of England Building as it will appear when the work of reconstruction and addition is completed. Another model which attracted some attention was that of the grandstand which was recently opened at Lord's Cricket Ground, a structure which is notable for its general slimness and the large overhang of the tiers, which is about 30ft. from the centre of the supporting girder system.

Professor S. M. Dixon demonstrated the process by which Aerocrete is made, and showed some samples of this very light concrete. By means of the admixture of a substance with the cement before gauging, gas is liberated in the semi-fluid mass, and honeycombed spaces are produced in it, giving a material of Sp. Gr. of from 0·5 up to the normal concrete weight as may be required. In an adjoining exhibit some interesting specimens of coloured concrete were placed on view by Mr. C. J. Goodwin. For the new process of colouring only those dyes which are fast to sunlight, moisture, and other atmospheric effects are employed. The concrete or coloured rendering is gauged, not with water, but with a simple derivative solution of organic dye, which is oxidised on becoming mixed with the cement, and so colours the cement particles in a permanent and insoluble form. Some pleasing tints in many shades of yellow, orange, brown, green, blue and gray were shown, and there would seem to be no reason why it should not be possible to tint concrete work so that it will harmonise with any reasonable colour scheme.

Notable among the metallurgical exhibits was a group of special steels shown by Sir Robert Hadfield. We need hardly refer to them in detail, for most of them were described in our article of April 9th last. An unfinished but completely machined rotor of ERA/ATV heat-resisting and non-scaling steel was on view, which has been designed for an exhaust gas turbine, and will work at temperatures between 800 and 900 deg. Cent., and at a normal speed of 30,000 revolutions per minute. It was tested at the very high speed of 53,000 revolutions. A selection of other special quality manganese and non-corrodible steels was also displayed, as were historical specimens relating to the corrosion problem.

Mr. H. Glaser sent a comprehensive selection of Monel metal parts, including cast, rolled, spun, woven, forged and machined articles. New applications of this metal included thin mouldings drawn on wood cores, while specimens of monel condenser tubes were shown. All difficulties connected with the manufacture of such tubes have now, we learn, been overcome, and condensers fitted with them have been in service for long periods with very good results.

Two applications of compressed air machinery were shown by Mr. R. L. Quertier. One was a two-stage Reavell rotary type compressor, designed to operate tramway brakes. The machine runs at 1500 revolutions per minute, and the rotors, which are only a few inches in diameter, are direct coupled to a 500-volt direct-current enclosed type driving motor. The other application was for a machine—one of several hundreds used by the National Institution for the Blind, Great Portland-street—for preparing zinc stereotyping plates for Braille printing. The indentations in the plates are made by a series of six styles, which are controlled by keys. With treadle operation it was found that the depth of indentation was affected by the fatigue of the operator. In order to eliminate this defect, a compressed air piston attachment, which is operated by a spacing bar in front of the keys, has been fitted to the machine, and it was shown in operation, being supplied with air at 12½ lb. pressure from a small motor-driven air compressor.

Another exhibit relating to blind persons was the Optophone, lent by Dr. Archibald Barr. This is an instrument which enables the blind to read ordinary printed matter. It was invented by Dr. Fournier d'Albe and has been developed by Dr. Barr so that a speed of from seventy to eighty words per minute is now obtained. In principle it depends on the use of selenium cells, the resistance of which varies according to the amount of light to which they are exposed. A light which is reflected on to the selenium tablets is broken up into six spots, by means of a revolving disc with six circles of perforations varying in number. These spots of light are projected on to the glass book-rest upon which the matter to be read is laid. They take the form of a vertical line about $^{3}/_{16}$in. in height.

Each of the spots of light represents a musical note in the telephone receiver attached to the instrument. The notes are produced by the interruption of the reflection from the white paper by the black printed letters on the page to be read. In this way a sound character for each letter in the alphabet is reproduced, and it is necessary for the person using the instrument to learn a sound alphabet. The Optophone is being employed successfully by several blind people. Dr. Barr also exhibited a 80 cm. base range finder for surveying work.

Two instruments of special interest to mining engineers were the ventilation and displacement manometer shown by Mr. John L. Hodgson and Professor Douglas Hay. The ventilating manometer is designed to replace the wind vane anemometer, which latter is so liable to derangement in practical mining use. It consists essentially of an extremely sensitive manometer in which a gauge tube of celluloid is so shaped as to give an equally spaced velocity scale, and is fitted with a zero adjusting attachment. Accurate readings of air velocities ranging from 2ft. to 30ft. per second can be taken with the standard instrument. It is levelled up and connected by a rubber tube with a cylindrical Pitot tip carried in front of the observer on a long wooden handle so as not to disturb the flow of air to be measured. It can equally well be attached to a pit prop in an airway. The manometer and its uses was fully described in a paper read by Mr. Hodgson before the South Wales Institute of Engineers in December last. The other instrument was a displacement manometer for making extremely accurate differential pressure measurements underground, especially at low air velocities. The instrument is provided with a chamber containing the displacer and an inclined gauge tube, which shows the level of the liquid in the chamber and which can be read by a microscope. Any difference in pressure applied to the chamber causes the zero level of the liquid in the gauge tube to move, and the amount of movement of the displacer which is necessary to bring the level back to zero measures the difference of pressure causing the movement. The displacer is operated by a micrometer screw with the necessary reading dials, a precision of about one fifty-thousandth of an inch of tube measurement being possible under working conditions. The instrument was fully described in Professor Douglas Hay's paper on "Mine Ventilation," which was read before the Midland Institution of Mining Engineers in April last.

Mr. Robert S. Whipple showed a vertical vibrograph and stress recorder of the Cambridge type in operation on a steel test bar, and typical records for passenger and goods trains when passing over bridges were displayed. Strain meters of the Foster type were also exhibited by Mr. W. R. G. Whiting, whilst Professor W. E. Dalby had lent his optical photographic recorder for giving the elastic and plastic properties of metals. Some interesting records of actual curves made with four types of this apparatus, namely, the elastic recorder, the breaking recorder, the push-pull recorder, and the torque-twist recorder, were on view.

Mr. Ivan C. Barling showed an improved construction for bunker doors in large bunkers for loading ore or coal into ships. If ordinary doors are used, only a portion of the bunker is effective, owing to the "dead" space between them. Further, the doors are likely to "hang up" and frequent disturbance of the mass by mechanical means is necessary in order to maintain a free flow of material. In the model shown these difficulties are got over by making the door—which takes the form of a rolling shutter—continuous from end to end of the bunker. The belt is flexible in its length, but is stiff in breadth, and as the sides of the door are supported by movable hangers each individual unit is effective in taking its share of the total weight independently of its neighbours. As the shutter door is rolled back a free opening is left and the material taking its natural slope cannot "scaffold."

The Metrology Department of the National Physical Laboratory exhibited a hob measuring machine for testing the spacing of hob teeth, whilst an experiment showing the effect of the resistance of a narrow connecting tubing on the efficiency of a high-speed vacuum pump was arranged. Mr. F. Gill showed some excellent photographs which had been transmitted by telephone between New York and Washington and New York and Chicago. The time for the transmission was about 7½ minutes. An electrical exhibit by Professor C. L. Fortescue showed apparatus for observing the nature of vibrations under controlled conditions and the tendency of thermionic valves to generate oscillations in unexpected ways. Dr. J. S. Owens showed the dust counter which is associated with his name, and several varieties of dust, both natural and industrial, while Mr. W. G. Walker exhibited a special adjustable type of fan brake dynamometer, and Mr. T. Clarkson an apparatus for demonstrating the circulation of water in a thimble-tube boiler.

THE report of last year's Committee on the safety of Westminster Bridge states that the bridge was as sound as when constructed, and that no appreciable deterioration of the superstructure need be apprehended in the next hundred years.

Television.

THE history of television dates from the discovery of the light-sensitiveness properties of selenium by May, who was one of Willoughby Graham's assistants. In 1873 this discovery was communicated to the Society of Telegraph Engineers, and it led to the construction of selenium cells by Siemens, Graham, Bell, and others. Very soon afterwards the idea occurred to a number of scientific investigators that selenium cells might make television possible, and Ayrton and Perry, Senlee and others described certain systems, but experience ultimately proved that the capabilities of selenium to respond to the immense speed of signalling involved were altogether inadequate.

So far as practical results were concerned, television remained for many years practically at a standstill, although from time to time schemes have been put forward which appeared practicable. The problem is much more complicated than it appears, notwithstanding that the general principle is comparatively simple. An image of the object to be transmitted is caused to traverse a light-sensitive cell which modulates an electric current, making it strong at the bright points and weak at the shadows, whilst at the receiving station the current controls a source of light traversing a ground glass screen in exact synchronism with the image at the transmitter. The spot of light is therefore bright at the high lights and dim at the shadows. A complete traversal of the screen is made in one-tenth of a second, and on account of the persistence of vision the complete image is seen by the observer.

The problem of devising suitable optical apparatus is not a difficult matter, but when attempts were made to put these devices into practical use the real difficulty associated with the problem became

FIG. 1—TRANSMITTING "TELEVISOR"

apparent, the difficulty being that of making the light-sensitive device give an adequate reaction at the stupendous speeds of signalling which are necessary.

A little over two years ago, however, Mr. J. L. Baird succeeded in transmitting shadows by television. The sending of simple shadows was, however, only a very short step in the direction of practical television, but towards the end of last year Mr. Baird was able to transmit a living human face from a transmitter in one room to a receiver in an adjoining room, and on January 27th of this year a demonstration of Mr. Baird's so-called "Televisors" was given at the Royal Institution.

A few days ago we had an opportunity of being present at a demonstration given at the offices of Television, Ltd., in Upper St. Martin's-lane, when the face of a person in the upper part of the building was made to appear on the screen of the receiving apparatus in the basement. Instructions to move the head, open the mouth, &c., were sent from the receiver to transmitter by telephone, and every movement was duly reproduced on the screen. True, the results left a good deal to be desired, for they did not in any way compare with those of the modern cinematograph, but they served to demonstrate that television has been made possible and that in all probability infinitely better results will be secured in the near future. Unfortunately, Mr. Baird is not at present willing to allow us to publish full technical details of his apparatus, but we hope to do so in due course. Briefly, the person being transmitted sits under the light of three powerful metal filament lamps to be seen in Fig. 1. Each of these lamps gives approximately 150 candle-power, although as the lamps are connected in series with a resistance, much more light can be obtained if it is required. By means of revolving shutters and lenses an image of the person being transmitted is caused to pass over a light-sensitive cell, it being first broken up by a grid. The current from the cell varies in proportion to the light falling upon it, and a fluctuating current is generated which is proportional to the light and shade of the image. This fluctuating current is transmitted in exactly the same way as the fluctuating current from the microphone is transmitted in telephony. The vision current can, in fact, be detected on a telephone receiver which will give a sound that varies with every scene that is being transmitted.

At the receiving station the varying current controls the light from a special glow discharge lamp placed behind an exploring optical device, similar to, and moving in synchronism with the exploring device at the transmitter. As we have already said, the main difficulty which has hitherto stood in the way of success has been that of obtaining an adequate response from the light-sensitive device, but technical details of Mr. Baird's method of overcoming this difficulty are not at present available. An alternative to the selenium cell is the photo-electric cell, which

FIG. 2—RECEIVING "TELEVISOR"

has been known for many years; but, unfortunately, the action of these cells is extremely minute, and as the light available in television is not only small in quantity, but also acts for an infinitesimally short period, it has been found impossible to obtain sufficient response even with the aid of the thermionic amplifier. The problem of synchronising has also apparently given rise to difficulties, which, however, have been successfully overcome. A view of the receiver at the offices of Television, Ltd., is given in Fig. 2.

SIXTY YEARS AGO.

OUR issue of June 15th, 1866, contained particulars of an extraordinary railway accident which had occurred on the Great Northern line on the previous Sunday night, the 10th. A train of empty goods wagons was despatched from King's Cross at about 11 p.m. and all went well with it until it was about halfway through the northern Welwyn Tunnel, some 22 miles out. This tunnel, about three-quarters of a mile long, was driven through chalk formation, and at its centre an air shaft, 50ft. in height, ascended to the surface of the overlying land. Just at this point one of the boiler tubes of the engine collapsed and nearly extinguished the fire by the rush of steam and water. The driver, finding that he could maintain enough steam to run the engine alone, decided to proceed to Knebworth, two miles further on, to obtain assistance. The guard, relying apparently on the signals at the entrance to the tunnel, neglected to return up the line in order to stop any following train. Fifteen minutes later a Midland goods train from London dashed into the end of the Great Northern train, smashing up the brake van, killing the guard and a man travelling with him, and upsetting the trucks across both lines. Almost immediately afterwards an up Scotch goods train entered the tunnel from the other end and crashed into the wrecked trucks obstructing the road. The Midland train was carrying inflammable goods, and in a very short time they caught alight from the fire of one of the overturned engines. Almost at once the tunnel was converted into a fiery furnace. The ventilating shaft was almost directly over the burning materials and acted as a most efficient stack. The flames ascending it are stated at times to have lit up the surrounding country. In the tunnel itself the smoke and heat were so oppressive that no steps could be taken to arrest the destruction. Nothing could be done except to allow the fire to burn itself out. It was not until the evening of the following day, Monday, that the tunnel could be entered. The damage to the brickwork lining of the tunnel was found to be slight, and in a short time the tunnel was again free for traffic. Commenting upon the accident, we were not disposed to attach great importance to the primary cause, the collapse of the tube in the Great Northern engine. It was too common an occurrence to deserve much attention, and as a cause contributing to the accident was overshadowed in importance by the failure revealed in the signalling system. According to the rules, two up trains or two down trains should not have been allowed to be in the tunnel at the same time. The two signalmen involved gave testimony against each other. In our opinion, the accident emphasised the necessity for making the distinction between the "yes" and the "no" signals between boxes more marked than it was, and of providing some means of automatically recording the signals sent.

IT is reported that a remarkable new lead pigment, for use in paint employed to protect iron against rusting, has been developed in Switzerland. The peculiarity of the material apparently lies in the fact that it liberates metallic lead in such a fine state of subdivision that the lead penetrates the surface layers of the iron and forms a protective coating.

An Improved Hexagon Turret Lathe.

THE evolution of machine tools, like that of practically all other productions of the engineer, has proceeded mostly by small separate steps taken as the result of direct experience. A detail here, another one there, is improved until in the course of time the improvements, additions and omissions may make it really difficult to recognise the original machine in its descendent. An interesting instance of this evolutionary process is provided in the case of the lathe illustrated in the accompanying engravings. This tool, the product of Alfred Herbert, Ltd., of Coventry, began its evolution in the firm's No. 4 hexagon turret lathe, designed a considerable number of years ago. It has since been developed and re-designed to such an extent that it is virtually a new machine, and is now the firm's No. 19 hexagon turret lathe. We were recently afforded an opportunity at the makers' works of seeing it in action, studying its design and comparing it with its forerunner, the No. 4 machine. The earlier design, as we saw it at

FIG. 2—WORK BAR SUPPORT

work, is still capable of giving a performance of a very high order. In the new machine improvement of performance, although it has been secured, is perhaps a less striking feature of the developments in the design than the steps taken to increase the effective life of the machine, the safety of its operator, and the convenience and ease with which it may be controlled.

Of the details designed to improve the durability of the tool, the most important is the fitting of protecting guards for the ways of the bed. These guards, four in number, are attached to the turret slide, two short guards extending to the right and two long guards, arranged to pass on either side of the headstock, extending to the left. They effectively cover the ways in all positions of the turret slide, and protect them from damage by chips, grit or accidental blows. They are bedded down on to the ways, and do not stand clear of them, a plan which is sometimes adopted, but which affords little or no protection against the erosion caused by grit, &c. A second item in favour of increased life is the extensive use made of ball and similar bearings. In the headstock all the gear wheel shafts run on ball bearings, of which there are no fewer than fifteen sets, in addition to two roller bearings and a double ball thrust bearing on the main spindle.

On the score of safety we have to notice that not only are all the gear wheels in the headstock and in the feed-box attached to the front of the bed, totally enclosed, but that the main driving belt pulley is completely enclosed in a guard, as are the belts whereby power is transmitted from the main pulley to the feed-box and to the rapid traverse shaft. Guards are also provided over the chuck and over the end of the work bar, where it projects to the left of the headstock. Another interesting safety precaution, although it is not wholly a novelty on this machine, may be mentioned, namely, the arrangement of the hand traverse star handle on the turret slide. Handles of this description, if allowed to rotate when the power feed or rapid power traverse is in use, have been known to cause unpleasant accidents. The four arms of the handle in Messrs. Herbert's machine are pivoted near their lower ends to act as levers on a clutch sleeve. A spring normally

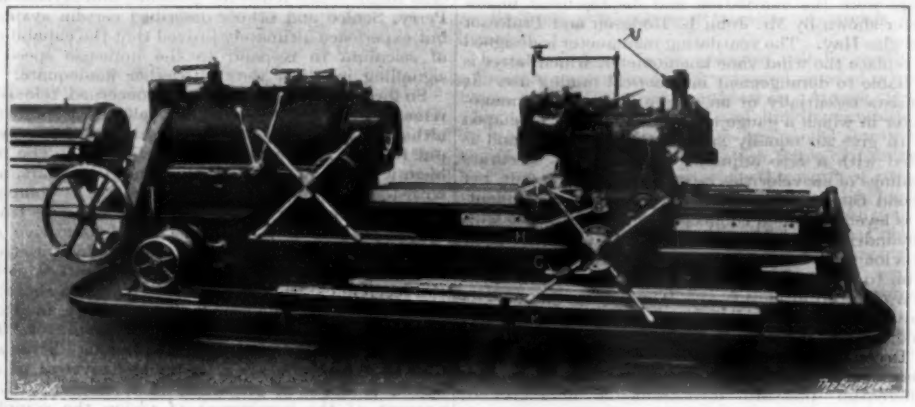


FIG. 1—FRONT VIEW OF HEXAGON TURRET LATHE

holds the clutch sleeve in the disengaged position in which condition the four arms all lie in a vertical plane. By pulling any one of the arms slightly towards him out of the vertical plane, the operator moves the clutch sleeve inwards and engages the clutch. The turret slide then responds to any rotation of the star handle, so long as one of its four levers is held in the forward position. On the release of the lever all four spring into the vertical position, and the clutch is disengaged. A subsidiary feature of this arrangement is that the star handle can be used after the manner of a ratchet for small adjustments of the turret slide position.

Under the heading convenience and ease of operation, several features engage our attention. The first is the means provided for moving the work bar longitudinally and clamping it in the chuck. When the semi-cylindrical cover guarding the rear end of the bar is turned back, it is found that—as shown in Fig. 2—the end of the bar is held in a three-jaw self-centering chuck. This chuck is mounted to rotate freely on ball bearings on a traveller, which can be moved along a tail rod by means of a chain, sprockets and a large hand wheel situated at the extreme left of the headstock. With the main or driving chuck loosened the bar can readily be moved through the spindle to the extent required to suit the piece of work being machined.

Facilities for freeing the work and re-gripping it at the driving chuck must necessarily accompany the facilities for moving the bar into a fresh position. The chuck with its cover removed is illustrated in Fig. 3, and in Fig. 4 it is shown in a partially dismantled state. It is of the collet

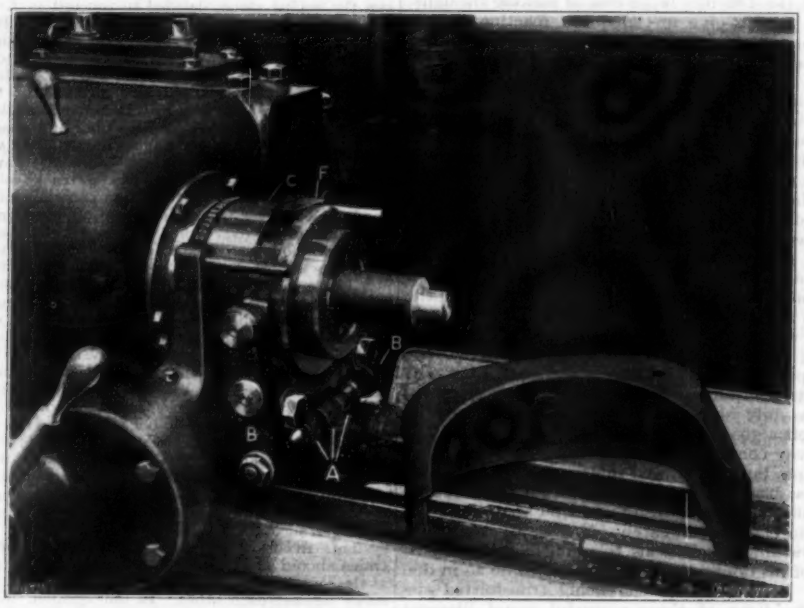


FIG. 3—DRIVING CHUCK WITH COVER REMOVED

type, and is operated by a toggle action after a pattern developed during the war to suit the limited strength of female operatives. The star handle whereby the chuck is opened and closed is geared in a ratio of about one to four to a quadrant on the end of a shaft, provided with three cranks. These cranks are connected by three links—the ends of which are visible at A in Fig. 3—to a cross bar mounted between two swinging side levers B. Pads at the ends of these side levers engage in a race turned in a sleeve C, surrounding and sliding on the chuck body. When this sleeve is moved backwards—that is, to the left—on the chuck body a hardened steel conical ring in its interior bears against six hardened steel fingers D—Fig. 4—and forces the upper ends of these fingers against a coned face on the chuck body. This action tends to force the fingers bodily towards the right. The lower ends of the fingers pass through slots in the chuck body and engage against a shoulder on a sleeve sliding within the body. The bore of this sleeve is coned at the front end to receive the coned backs of four collet pieces. When therefore the star handle is rotated and the sleeve C is moved to the left, the fingers D are forced downwards and towards the right carrying the internal sleeve with them, and closing the collet pieces down on the work. The force in this instance is transmitted through the middle link of the three links A, which link and its associated crank provide the toggle action. The eye of the link is elongated, so that if mere pressure on the star handle is not sufficient to close the collet pieces tightly on the work, the star handle may be rotated backwards a little and brought up again to cause the link to exert a hammer blow on the cross bar. The two outer links A exert a toggle action on the cross bar in the reverse direction, for the purpose of opening the chuck and are also capable of being used hammer-wise.

The chuck cover, it may be noted, slides on two pins E, and when in position is connected by a set screw to a pad F lying in the race of the sleeve C. The cover is thus caused to move longitudinally with this sleeve, when the chuck is being opened and closed. It will be gathered that the chuck may be opened, the work moved longitudinally,

FIG. 4—CHUCK PARTIALLY DISMANTLED

and the chuck closed on it again with equal facility, whether the spindle is running or stopped.

Passing to the turret and its slide, we find that the following motions are provided:—(1) Hand traverse of the slide by means of the safety star handle already referred to; (2) quick power traverse of the slide; (3) longitudinal feed of the slide; and (4) power rotation of the turret. In addition to these motions, certain of the tools on the turret are mounted on slides to which hand feed may be applied. The hand and quick power traverses and the longitudinal feed are all applied to the slide through one rack and pinion. For the power feed rotation is imparted to the pinion through a worm and worm wheel driven from a spline shaft extending along the front of the bed. The handle G—Fig. 1—controls the starting and stopping of the feed by lifting or dropping the worm. For the rapid power traverse the rack pinion is caused to rotate by taking power from a spline shaft passing down the back of the bed, the engagement of the motion being effected by means of the handle H, which controls a positive clutch in the rear apron of the saddle. The power rotation of the turret, controlled by the handle J, is also derived from the rear spline shaft. The handle J in addi-

tion to clutching in the power rotation, withdraws the turret locking bolt. When it is depressed the turret rotates until it is released when the turret will stop in the next station to register with the locking bolt. A hexagonal rod provided with six stops extends along the front of the bed, two in number, are operated by one hand wheel, which, when rotated, engages the nine feeds in successive order. A dial behind the hand wheel indicates by a number on its edge the particular feed in engagement at any moment. Between the loose wheels spacing washers are placed. Both clutches are of the same design. In each case a flange keyed to the spindle carries, loosely pinned on one face, an element in the form of a ring with a short portion of its periphery removed. This ring is very slightly smaller than the bore of the wheel P or R, within which it and the

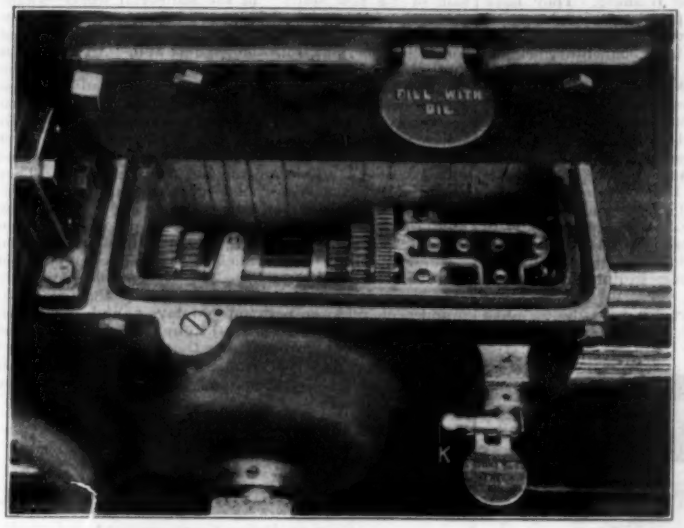


FIG. 5—CHANGE-FEED GEAR-BOX

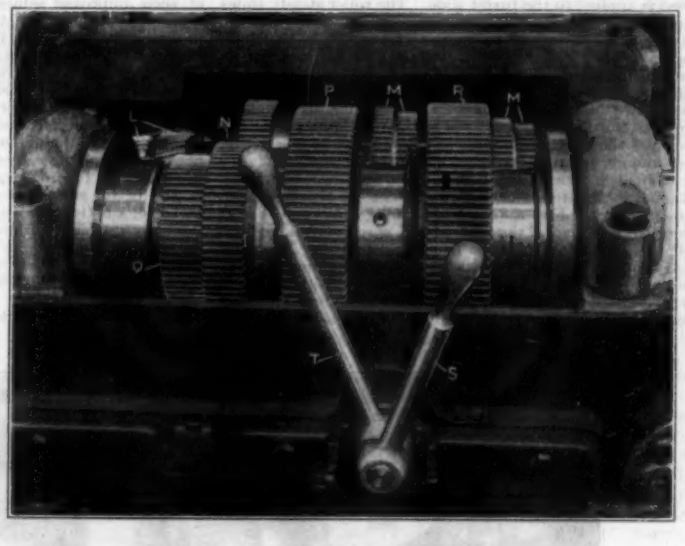


FIG. 6—INTERIOR OF HEADSTOCK

and is connected by gearing to a shaft lying between the ways of the bed. This shaft, in turn, is geared through mitre wheels to the turret. The stop rod therefore rotates with the turret, so that in each station of the turret an appropriately positioned stop is presented to drop the

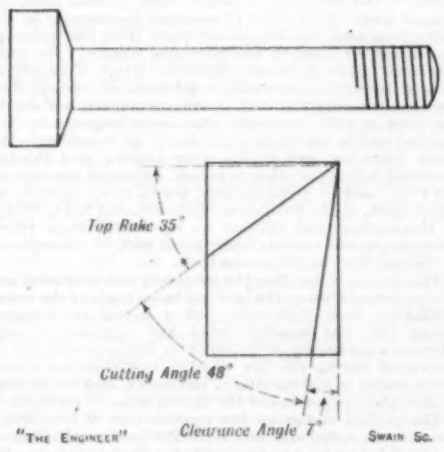


FIG. 7

worm and interrupt the longitudinal motion of the turret at the required instant.

The gear-box driving the feed shaft is shown in Fig. 5. It provides nine rates of feed, ranging from 21 to 172 cuts per inch. There are six wheels on the first shaft and six on the second, and the pairs are always in engagement. The three left-hand wheels on the first shaft and the three right-hand wheels on the second shaft are connected to their respective shafts by permanent keys. Either of the three left-hand wheels on the second shaft and either of the three right-hand wheels on the first shaft can be connected to their shafts by sliding feather keys. These sliding keys, These washers are formed with tongues which project into the groove in the shaft in which the feather key slides. Their object is to depress the key when it is passing from one wheel to another, and so prevent two of the wheels being momentarily engaged at the same time. The gears can be changed without the drive being stopped. In fact, with the machine running full speed, the whole range of feeds from the highest to the lowest can be passed through without shock as quickly as the operator can turn the hand wheel. Reversal of the feed motion is effected by means of the small handle K—Fig. 5—which controls a dog clutch sliding between bevel wheels. The feed-box is driven by belt from the main spindle, a common practice nowadays in machines, which, as in this case, are arranged to screw by means of a die head and not by chasing.

The headstock—Fig. 6—is equipped with gearing giving sixteen spindle speeds ranging from 13 to 397 revolutions per minute, in addition to gearing which controls the starting, stopping and reversing of the motion. With the starting lever in one position the drive is transmitted direct from the belt pulley on to the first shaft—not visible in Fig. 6. When the starting handle is thrown over into the other position, the drive from the belt pulley is transmitted to the first shaft in the reverse direction through the helical gearing L journaled loosely on the second shaft. Four sliding wheels on the first shaft can be mated with the four fixed wheels M on the second shaft. Each of the four speeds thus given to the second shaft can be transmitted either on to the wheel N or the wheel P, the selection being governed by a clutch controlled from the handle S. The wheels N and P are solidly connected together, and may be coupled directly to the main spindle by engaging a clutch lying within the wheel P and operated by the handle T. Eight speeds can in this way be communicated to the spindle. The remaining eight are obtained by throwing the handle T over to the right, an action which frees the wheel P from the spindle and engages the wheel R with it. The transmission then proceeds, either through N or P to the wheel Q, which is keyed to N and P, and thence through a shaft—not visible—on to the wheel R. With the exception of the wheels M and their mates on the first shaft, all the wheels in the spindle drive, including the helical wheels L, are in constant engagement.

Perhaps the most interesting feature in the headstock details is the design of the clutches, whereby the wheels P and R may alternatively be engaged with the spindle. flange lie. It is expanded into engagement with the bore by the action of two small ball-ended rods bearing on the cut ends of the ring. These rods when the clutch is free lie at a slight angle to each other, and when the clutch is to be engaged are forced toggle-wise into collinearity by the pressure exerted on them by the sliding member lying between the wheels P and R.

The tool equipment on the turret may be described with reference to the machining of a bolt or centre pin of the form shown in the upper part of Fig. 7. The first turret face to be brought into action is that illustrated in Fig. 8. This face has three stations, instead of the normal one station. In the first station the stop A is brought on to the centre line. With the turret slide positioned longitudinally by the stop on the hexagonal bar at the front of the bed the work bar is advanced against the stop A and the clutch closed on it. The turret is then rotated until the tool B is on the centre line. With the centre C advanced

FIG. 8—TOOL EQUIPMENT FOR STEPPING AND ENDING WORK BAR

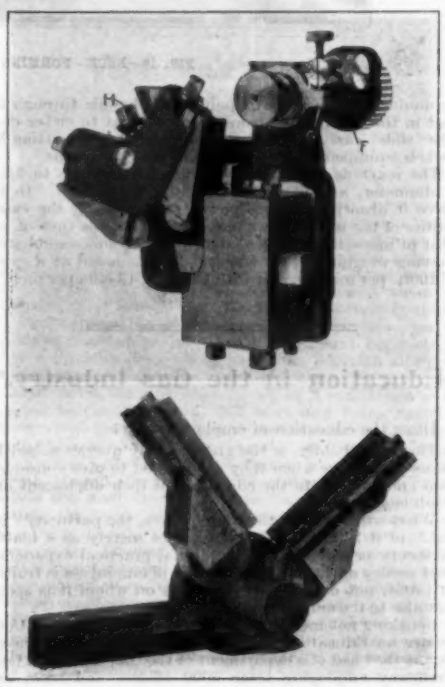


FIG. 9—ROLLER STEADY AND TURNING TOOL

against the end of the work sufficient support is obtained to enable the tool B when fed downwards by hand to clean up a length of about half an inch of the surface and reduce it to a diameter of substantially the finished size. In the third position of the turret face this machined step on the bar is held in the roller steady D, while the tool E forms the curvature on the end of the work.

The second, third and fourth faces are equipped with the roller steady and turning tool fitting—shown in Fig. 9. The tools, of the section shown in the lower part of Fig. 7, are ground without forging or machining from a rectangular bar of high-speed steel. In the lower part of Fig. 9 we illustrate the tool in action, and show it in relation to the work, the chip and the steady rollers. As will be seen from the upper view in Fig. 9, the tool is fixed in its slide between two elevating and two clamping screws. Horizontal hand motion is imparted to the slide in an inward or outward direction by means of a rack and pinion, a worm wheel and a worm, the operating handle being shown at F. On the worm shaft a stop G is fixed,

which works in conjunction with an adjustable stop screw. This stop screw can be slid out of the way of the stop, so as to permit the feed handle to be given as many complete turns as desired before the stop is brought into action, and also to allow the tool to be withdrawn clear of the work before it is returned to the starting point. When the tool has been fed to the required depth, longitudinal power feed is applied to the turret slide. The roller steady slides are adjusted to the required diameter by screws and are simultaneously locked by means of the screw H, which operates by forcing inwards two pins bearing against its coned shoulder. The pins carrying the rollers are cut down to a semi-circular section on each side of the rollers. As shown in the lower view in Fig. 9, this arrangement enables the rollers to be placed in the plane of the tool and permits the work to be reduced in diameter at one cut by an amount equal to the roller diameter.

The fifth turret face carries a "Coventry" die head. The sixth is fitted with the equipment shown in Fig. 10. In this view, J is a tool for forming the conical seat beneath the head of the bolt, and K is a reversed cutting-off tool operating from the back of the work. The tools are mounted on a slide which can be fed horizontally inwards and outwards by means of a rack, pinion, worm wheel and worm. The operating handle is a long rod, best seen at U in Fig. 1, the leverage of which can, if required,

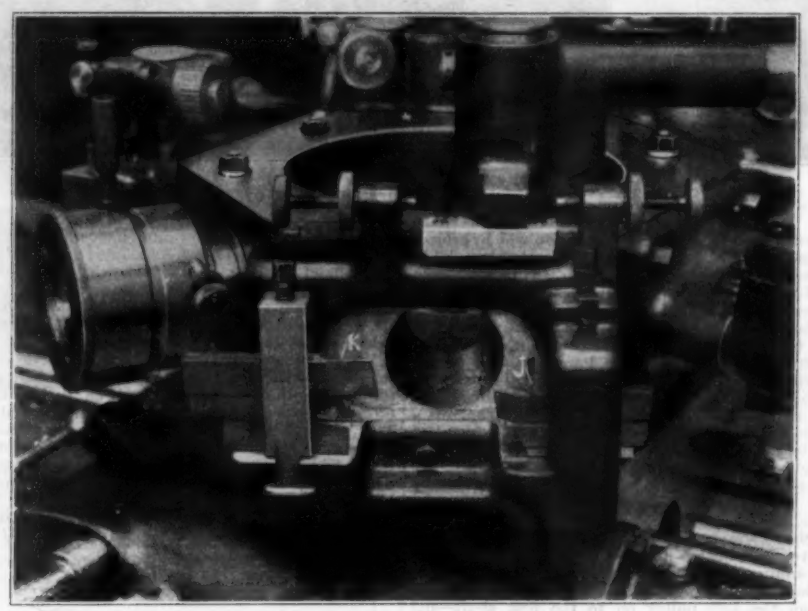


FIG. 10—NECK-FORMING AND CUTTING-OFF TOOLS

be doubled by pushing or pulling the handle through its seat in the worm shaft from the mid point to either end. The slide carrying the neck-forming and cutting-off tools is equipped with dead stops in both directions.

The machine is capable of admitting bars up to 3¼in. in diameter, and of turning lengths up to 42in. In its drive it absorbs 10 horse-power. As showing the capabilities of the machine, we may say that at the time of our visit of inspection we were shown a continuous mild steel shaving weighing 5¾ lb. which it had removed at a speed of 100ft. per minute, and with a feed of 13 cuts per inch.

Education in the Gas Industry.*

DOES the education of employees pay?

That, put baldly, is the gist of many queries raised by many employers when they are pressed to give consideration and support to the education of their adolescent and adult employees.

What will the firm, the shareholders, the partners, "get out" of it? Can anybody say, not merely as a matter of theory or belief, but from actual practical experience, that money spent on the education of employees is fruitful of profit, not only to the employee on whom it is spent, but also to the employer who spends it?

Speaking not merely as chairman of the Advisory Committee on Education to the Institution of Gas Engineers, but as the head of a department of the Gas Light and Coke Company employing some 5000 officers and men, and having fortunately at its head a man—the governor, Mr. D. Milne Watson, M.A.—who is an ardent advocate of education of employees, I can answer those questions very definitely in the affirmative, after experience of nearly twenty years of schemes for the education and training of workmen and staff.

I am certain, beyond the possibility of a doubt, from my own actual experience and observation during those twenty years, and from the reports made to me by the administrative officers of the department, that money spent on properly-devised and efficiently operated schemes for the education of both adolescent and adult employees is a sound and highly remunerative investment, not an "expense" at all, in the generally accepted sense of the word. Money spent on education does not increase costs; it reduces them. It profits him who gives and him who receives. It increases the earnings of the employee, because it increases his value to the employer. Let me be quite definite. It has in fact increased the earnings of employees because it has in fact increased their value. The Gas Light and Coke Company have increased the maximum rates of pay of certain classes of officers in their service, and the annual increments of pay whereby the maximum rates are reached, because they have found they are getting more valuable employees as the result of their improved education and training. They have been able to promote to staff positions of substantial present value and good future prospects a higher proportion of lads entering their service from elementary schools than they could find worthy of promotion before their educational schemes came into operation. They have been able to give much improved service to the community as the result of possessing a better average quality of employee; and they have consolidated their existing business, increased the rate of progress of their business, and improved the future prospects of their business, as a result of the better service they have been able to render by means of a better educated staff of officers and workmen.

Those are facts within my personal knowledge. They are not speculations or mere probabilities. They are definite results. They are, moreover, confirmed by the experience of other gas undertakings in different parts of the country.

Those are very direct and obvious advantages, alike to the employer and to the employed. There are others, less obvious perhaps, but none the less real that have accrued in our experience. They are indeed closely related to and, in no small degree, productive of the direct and obvious advantages of improved and growing business.

There can be no doubt that the employer—whether individual, company, or corporation—who institutes or supports schemes of education for the workers gains in money, as well as in the improved harmony of operation, through having more intelligent people to deal with, and through having employees who take increased pride in the business, who have developed *esprit de corps*, and who feel personal interest in the firm's good name, its progress and its prosperity through their increased knowledge and through their appreciation of what has been done for them in the field of education.

The British worker is highly responsive to genuine efforts to aid him in his self-development and advancement, to practical evidence of goodwill and co-operation, and, especially, to the knowledge that he can earn promotion through merit, and in no other way. Justice is the quality in the employer that makes the strongest appeal to the employee.

An education scheme in connection with any business necessarily implies that in that business close attention is paid to merit; and I know of nothing more productive of profit to the employer than certainty in the minds of the employed that the road to promotion from bottom to top is open to all through merit and merit alone.

Education for vocation almost inevitably carries with it education for leisure; and it is of no small moment to the employer that the greater hours of leisure rightly available to-day for his employees should be productive of increased intelligence, of wider outlook and deeper thoughtfulness in the general body of his employees. Wider outlook and truer harmony also come from the meeting together of varying grades of employees for purposes of common study and instruction. Indeed, the "atmosphere" created by the institution of educational schemes, supported and encouraged by the employer, and by the co-operation of differing ranks in their working—an atmosphere that is reflected in the increased happiness and goodwill of all ranks, and in the hopes for the future of themselves and their children that are aroused in the hearts of all—constitutes an asset of no mean order for the business, and, through the business and through the individuals employed, for the community as a whole.

Again I would say, these are not speculations or deductions from a theoretical consideration of the subject. They are the result of direct personal observation of the actual operation of educational schemes in practice; and they are the opinions which led those responsible for the inauguration by the Institution of Gas Engineers of their scheme for education in the gas industry to put their hand to that task.

* * * * * *

Let me repeat my firm belief, based on practical experience for many years, that the education of employees on sound lines, when not merely countenanced but positively encouraged by employers, does definitely stimulate goodwill in industry. It is not merely that the men are made better craftsmen, more efficient tools. It is not even merely that you get men of better character and greater sportsmanship. There is always a great deal of vague talk of "a new spirit" in the industrial world—vague and not very helpful so long as we forget that this new spirit must come not only from the heart, vital though that source of it be, but from the head as well. An intelligent and informed body of workmen would better understand the problems of an industrial age. They would see that grievances existed not to be harboured as grievances but to be removed; and they would know how to set about removing them by approaching employers in the right way, and with the knowledge that these employers cared for the men's advancement and true interests. They would realise the better that management has its difficulties and anxieties and risks, as well as its remuneration and profits; that, indeed, employers often have grievances against the employed which arise out of ignorance and misunderstanding and which better education would remove or prevent. And, further, they would inevitably come to recognise more and more clearly the true community of interest between employers and employed, understanding of which is vital to industrial stability and progress. It is only in that way that a useful goodwill set upon a sure foundation can arise; and that in the last resort is the best argument—nay, the imperative reason—for education in industry.

* From a paper by Mr. F. W. Goodenough, C.B.E., chairman, Education Committee of the Institution of Gas Engineers, presented at the eighth annual Conference of the Association for Education in Industry and Commerce, at Birmingham, on Thursday, June 10th, 1926.

The Sutlej Valley Irrigation Project.

(From an Indian Correspondent.)

IN the absence of Lord Irwin, the Viceroy, Sir Malcolm Hailey, the Governor of the Punjab, early in April opened the great Suleimanke Weir, which is the first of the four weirs of the well-known Sutlej Valley Irrigation project to be completed. The object of this great project in the Punjab is threefold. First, it is proposed, by the provision of weirs and head regulators to afford to the existing canals a controlled supply from the beginning of April to the middle of October, so as to render them immune from the present detrimental effect of sensonal fluctuations in the water level and thus to convert them from the status of inundation to that of non-perennial canals. By non-perennial canals is meant canals to which a supply is assured during the hot weather and monsoon, though they are closed during the cold weather when the volume in the river is low. Secondly, the areas irrigated by the existing canals are to be extended so as to embrace the whole low-lying area in the river valley; and thirdly, perennial irrigation—that is to say, irrigation throughout the year—will be given to large tracts in the uplands on either bank, in the Punjab on the north, and in the States of Bahawalpur and Bikaner on the south, these tracts being at present entirely unirrigated and, in consequence of the very low rainfall, waste lands.

The system of dividing the irrigation into perennial and non-perennial ensures the best use being made of the water available. Only 7000 cubic feet a second are required during the cold weather, when the supplies are low, whereas a maximum of 48,500 cubic feet a second will be drawn off during the hot weather and monsoon times, when, owing to the melting of the snows, and the rainfall in the catchment areas of the rivers, water is plentiful.

The project comprises the construction of four weirs, three on the Sutlej and one on the Punjnad, as the Chenab is called below its junction with the Sutlej, with twelve canals taking off from above them. This multiplicity of weirs and canals might seem to be a peculiar feature if the immensity of the whole scheme were not taken into consideration. The project really consists of four interconnected systems, each of the first magnitude. Each weir will control about one and a-quarter million acres of irrigation, the total annual irrigation from all the weirs being nearly three times that contemplated under the Triple Canal project, the largest system constructed in India up to date. It has, however, been found economical, in order to obviate the loss of water entailed in carrying small supplies in very large channels, to provide separate canals for the perennial and non-perennial irrigation, the existing inundation canals being linked to the latter.

The total gross area to be irrigated under this scheme is 8,868,473 acres, or 13,857 square miles. Out of this about 36½ lakhs of acres will be under perennial irrigation and about 52½ lakhs under non-perennial irrigation. The perennial canals will have a maximum capacity of 14,000 cusecs and the non-perennial canals a maximum of 34,000 cusecs.

The most important area in the Punjab to be placed for the first time under irrigation is a comparatively high-lying tract known as the Nili Bar, which forms part of the watershed between the Sutlej and the Chenab, where the rivers approach closely to one another. The Suleimanke Weir, the first to be completed, and now opened, will give this a perennial water supply and altogether will serve canals affecting 2,890,363 acres. The three higher of the four weirs—the whole of the purely British units and the Bikaner Canal—are due for completion by the end of 1927–28. It is hoped to finish the Bahawalpur canals from the Suleimanke and Islam weirs by the end of 1929–30. The canals from the Punjnad Weir, the last weir to be completed, are to be ready by 1932–33. The programme of construction of the Bahawalpur Canals depends on the pace at which the State can provide funds for executing the work. The State of Bikaner is itself dealing with its own canal construction.

An important feature in the construction work is the introduction of power machinery. Powerful mechanically operated dragline excavators have been employed, some of them having buckets 24ft. long.

The total cost of the undertaking is now estimated at the equivalent of £15 millions, and the annual return of the scheme is expected eventually to amount to nearly 38 per cent.

Institution of Mechanical Engineers.

SUMMER MEETING AT IPSWICH.

IN spite of the doubts which existed only a fortnight or so ago with regard to the desirability of holding the summer meeting of the Institution at Ipswich as arranged, and notwithstanding the difficulties which existed with regard to travelling for those members who live at some distance from the proposed rendezvous, as things have turned out the Council acted wisely in proceeding with its programme. Under all the difficult circumstances the attendance of members and their ladies was surprisingly good—the number must have exceeded 300. Everything possible had been done by the local committees in Ipswich, Norwich and Chelmsford to make the meeting a success. A splendid and varied round of visits to engineering and other works kept the members fully interested from early morning till evening each day, and the hospitality of the hosts was typical of East Anglia.

In welcoming the members at the Town Hall, the Mayor of Ipswich, Mr. K. J. Badshah, said that the Institution had rendered the town a two-fold honour—by electing as its President one of its prominent citizens, who but for that would have worthily filled the place he (the Mayor) now occupied. It had also honoured Ipswich by its visit to a town in which the ancient and the modern lay "cheek by jowl." Colonel F. W. Turner said that he represented one section of their community, the Engineering Society, and as the President of that Society he offered a special welcome to the Institution. What the Institution was to the world the Society was to Ipswich.

Upon taking the chair, the President, Mr. W. Reavell, returned thanks for the welcome which had been extended to the Institution. He then presented the Willans Medal to Mr. P. C. Dewhurst, of Columbia, for his paper on "British and American Locomotive Design."

The first paper to be read was that by Mr. Frank Ayton (Ipswich) on "Applications of Engineering to Agriculture." An abstract of it is given on page 647. There was an interesting discussion of this paper, the first speaker being Mr. C. Wicksteed, who narrated his early experiences of agricultural engineering as far back as the use of the flail for thrashing. He recalled that Kitsons were the first makers of the steam plough, and they succeeded where others had failed because they adopted locomotive practice and had the best men.

Mr. W. Worby Beaumont, in the subsequent discussion, said that the author had dealt with his subject like a literary thrashing machine, by picking out its most important features. Mr. Beaumont's remarks were largely in reminiscent vein, and he gave some of his early experiences, including the experiments in steam ploughing in 1857 with a 7 horse-power engine on the movable anchor system. He said that the earliest thrashing machine was built in 1842, when the first set was made at Ransome's works, Ipswich. The first portable machine invented by himself received the silver medal of the Royal Agricultural Society of England, and that medal he still had in his possession. Unfortunately, so great was the prejudice of farmers towards the plant that they would not allow it to go on to their farms without a special insurance against fire was taken out, and it had afterwards to be operated by horse gear.

Other speakers on this paper were the High Sheriff of Ipswich, Alderman Sir Edward Packard—who said that one of the present requirements was a drum drill for sowing beet seeds—Mr. Martin, Sir Ernest Petter, Brigadier-General Mowat, Mr. Hobbs, and Mr. Dewhurst. Sir Ernest Petter said that the greatest difficulties which the agricultural tractor builder had to contend with were the extremely various types of land which were met with. We in this country would have to devote all our energies in the future to the production of our own foodstuffs, and that could be done by better methods.

Mr. Hobbs remarked that agriculture was frequently looked upon as the Cinderella of industries. He mentioned that there was not even a good book on agricultural engineering, nor an agricultural engineering society such as there was in the United States.

Mr. Dewhurst described some of the conditions with which farmers had to contend with in Columbia.

Mr. Ayton briefly replied to the speakers.

The discussion on Lieut.-Colonel F. W. Turner's paper on "Flour Milling Machinery," of which we commence to print an abridgment on page 635, was opened by Mr. Cecil Bentham, who said that the paper was largely descriptive and avoided debatable matter. The machines described were simply units. The chief factor to be aimed at in the equipment of a flour mill was reliability. The plant had to run twenty-four hours per day, and fifty-two weeks in the year, and he had known machines which had been running for thirty years. The science of milling consisted in the separation of the digestible part from the indigestible part of the grain. The theoretical amount of digestible material was from 77 to 80 per cent., depending on the kind of wheat, and in practice 70 to 72 per cent. was produced as flour, 10 to 15 per cent. was a low-grade mixture, and the balance was bran. The machinery described was typical of European practice. American practice varied considerably. The roller mills ran about double the speed of British mills, and were driven by belts, no gears being used. The feed was heavier, and the power required was greater. With regard to pneumatic conveying plants, Mr. Bentham said that by them grain was being conveyed 700ft. per minute. One of the advantages of the pneumatic plant was that in the course of its operation it performed the additional service of cleaning the wheat. The dust filter described in the paper was out of date in this country. It blew the dust into the room. Mr. Bentham also criticised the construction of the whizzer, which, he said, was designed on a wrong principle.

Mr. Pachell, the next speaker, said that the original inventor of pneumatic unloading was Mr. F. E. Duckham.

Mr. W. Worby Beaumont said that the firm of Turner's was the first to apply the principle of the vibro-motor—invented by himself—to sieving machinery. He described the difficulty of balancing machines by means of cranks. Mr. Jennings and Mr. Strohmeyer also took part in the discussion, which was briefly replied to by Lieut.-Colonel Turner.

THE DINNER.

The Institution banquet was held at the Felix Hotel, Felixstowe, on Tuesday night Mr. Reavell, the president, being in the chair. There was quite a large number of ladies present, and as the toasts were commendably few, and the speeches of more than average merit, a very pleasant evening was spent. The toast, "The Industries of East Anglia," was proposed by Mr. Daniel Adamson, who made a very happy contribution to the proceedings. He said that many industries had developed from the yeoman farmer of many years ago. Speaking as a Lancashire man, he could testify to the successful incursion of agriculturists into the cotton trade and the family tradition which had been built up. The man engaged in agricultural pursuits knew that unless he put something aside from one year's crop towards the next he would have no seed, and he, Mr. Adamson, felt that many of the difficulties of the engineering industry might be attributed to the neglect of that factor.

The toast was responded to by Sir William Burton, who referred to some of the multifarious industries of East Anglia, and wound up by saying that despite the coal strike, which was strangling every industry in the country, there were bright signs in the industrial outlook, and he wished prosperity to the engineering trade in all its aspects.

Mr. H. N. Gresley proposed the toast of "The Reception Committees," and paid a really well merited compliment to the hosts of the Institution for the great hospitality which was being extended to the members. He also referred to the misgivings of the Council as to whether the meeting should be held in view of the disturbed conditions of the country. That it had been wise in holding the meeting, however, was proved by the splendid attendance of members. The Institution was very grateful to the Mayor of Ipswich, to Mrs. Fletcher, to the Lord Mayor of Norwich, and particularly to Captain Kingsley Reavell for the excellence of the general arrangements. This toast was responded to by Mr. Thomas Glover, the Lord Mayor of Norwich, who said that Norwich was looking forward to the visit of the Institution, and that while the city would show the members interesting historical records, it would also show that it was by no means at a standstill. There they would see modern developments due to mechanical engineering.

Sir John Ganzoni proposed the toast of "The Institution," coupled with the name of the President. He said that the honour paid by the Institution to Mr. Reavell was much appreciated in Ipswich, to the civic life and public service of which town Mr. Reavell had devoted many years of service. The President's reply was a very happy effort. He said that the membership of the Institution was approaching 10,000 and he sincerely hoped that during the year of his presidency the 10,000 mark would be reached and passed. Speaking of the work and records of the Institution, the President said that, despite its past accomplishments, he was one of those who believed that the things that had been done were but the earnest of the things it yet would do. In this mechanical age the things that lay ahead of them were infinitely greater than those of the past. New branches of their work naturally drew round them coteries of men who wished to discuss particular developments, and, as he saw it, the future of their great institution was that of a central body which controlled affairs, with groups or separate sections dealing with particular branches of mechanical engineering, all of them working together for the benefit and advancement of the profession of which they were so proud. He was, he said, a confirmed optimist, and had immense faith in the future of the British engineer who was a keen inventor, a clear reasoner and a hard worker. The next generation would record still greater advances for the benefit of British engineering and for the nation and Empire, and would further the scope of the Institution of Mechanical Engineers.

VISITS TO WORKS AND PLACES OF INTEREST.

The programme of excursions and visits was a very comprehensive one. On Tuesday after luncheon in Christchurch Park, by invitation of the Ipswich Reception Committee, visits were paid to the works of Ransomes and Rapier, Reavell and Co., the Ipswich Docks, and Gabriel, Wade and English. After these the members and their lady friends were entertained at a garden party by the President and Mrs. Reavell at their beautiful home, "Broadwater," the gardens and distant views being greatly admired. In the evening the dinner was held at the Felix Hotel, Felixstowe. Wednesday was devoted to alternate visits to several works, including, in the morning, Ransomes, Sims and Jefferies, E. R. and T. Turner, and Vickers-Petters. A civic luncheon in Christchurch Park, by the invitation of the Mayor, followed. In the afternoon the visitors had opportunities of inspecting the docks and dock appliances at Parkeston, making the journey from Felixstowe by motor boats. From Parkeston they were taken by motor boats to Harwich to view the Great Eastern train ferry system. Another party of members visited the R.A.F. seaplane station and marine aircraft experimental establishment, where demonstrations were given. This visit proved an irresistible attraction, and those who were fortunate enough to go had a very interesting time. The party was welcomed by Wing-Commander Maycock. The station covers a very large area. After hearing a lecture by Flight-Lieutenant Cross, popularly known as "little Bernard," on the Seaplane, accompanied by a cinema, the staff provided an exciting entertainment of flying, with four machines, comprising a Fairey III. D., with a 450 horse-power Napier Lion engine, a Fairey "Flycatcher" single-seater, with a 385 horse-power Siddeley Jaguar engine, an E.E.C. Kingston wooden hulled machine with two Napier Lion engines, and a F. 5 Short plane with a duralumin hull and a 350 horse-power Rolls-Royce engine. In the sheds there were on view the four-engined seaplane Titania, 146ft., span and a sister plane. Tea was provided for the visitors, and the famous band provided a musical interlude. On Thursday Norwich was visited, and there the works of Laurence, Scott and Co., Boulton and Paul, the Corporation Electricity Station, the British Gas Light Company, and the mustard factory of Messrs. Colman were thrown open. Luncheon was provided in St. Andrew's Hall by invitation of the Lord Mayor, Mr. Thomas Glover. After lunch a party visited Wroxham and Horning Ferry. Chelmsford and Colchester are to be visited to-day—Friday. In the former town the works of the Hoffmann Manufacturing Company, the Marconi Wireless Telegraph Company, and Crompton and Co. are to be visited, while at Colchester the works of Davy, Paxman and Co. and A. and G. Mumford will be open to view.

PAPER PULP IN FRANCE.

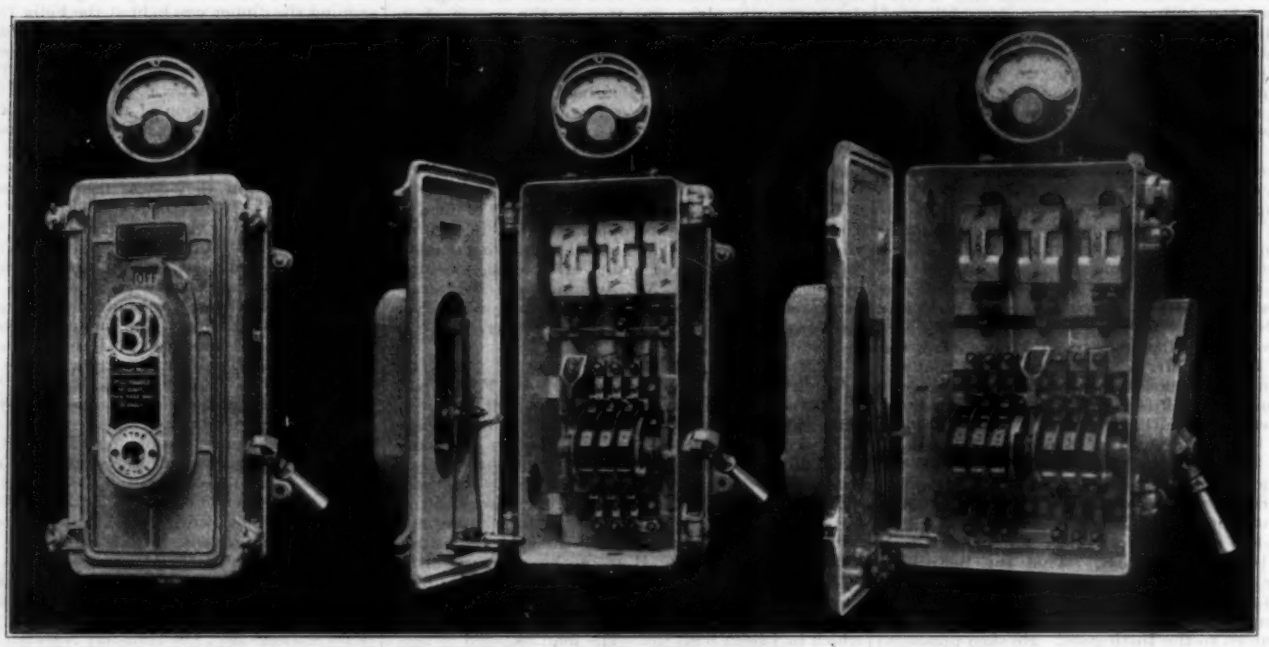
NEARLY all the countries which supply wood for the manufacture of paper pulp are now limiting its exportation. In Europe a restriction has been placed upon the consignments of such wood from Poland and Czecho-Slovakia, and similar action is likely to be taken by Finland, so that the only considerable source of supply remaining is Russia. The situation is regarded as very serious for the pulp mills in Holland, Belgium and Germany, and in view of the heavy increase in the cost of imported pulp, the French are beginning to take measures to utilise as much as possible their own products. At present there are very few pulp mills in France. One has been in operation in the Department of the Oise during the past year for the manufacture of pulp from straw, and big factories in the Vaucluse are making pulp from Algerian alfa grass or esparto. Except for these requirements, practically the whole of the alfa grass grown in North Africa is exported to Great Britain, and it is now being urged in France that the raw material should be reserved for French pulp mills when a sufficient number of them is installed. It is quite possible that the British monopoly over the North African alfa grass may be challenged in the future, unless the production should be increased sufficiently to satisfy the needs of both countries. Arrangements are also being made to manufacture paper pulp from the pine trees in the Landes. Several mills are being erected in that department, and there is no doubt that, if the results prove satisfactory, their number will be increased until France possesses an important pulp making industry. An obstacle in the way of such progress, however, is the threatened destruction of forests at a time when an extensive scheme of afforestation is regarded as necessary for the country's welfare.

A MESSAGE from Bogotá states that the serious transport difficulties in Colombia caused by the drought, which has occasioned the almost complete stoppage of traffic on the Magdalena River, have compelled the Government to proceed without further delay with the completion of the dock works at Buenaventura. The project, which hitherto has made only moderate progress, comprises the construction of a wharf alongside the pierhead at which lighters can tie up. The new construction will have a frontage of 700 m., where at least six vessels will be able to berth. At present there is only one pier, providing a loading berth on one side and a discharging berth on the other; alongside it, ships drawing more than 22ft. of water cannot safely approach. The larger number of vessels that visit Buenaventura draw a minimum of 27ft., and must therefore discharge their cargoes into lighters, from which they are lifted by cranes. For these operations additional cranes have been ordered. A large tract of land on the north side of the island will be reclaimed, and on it will be erected warehouses, docks, &c.

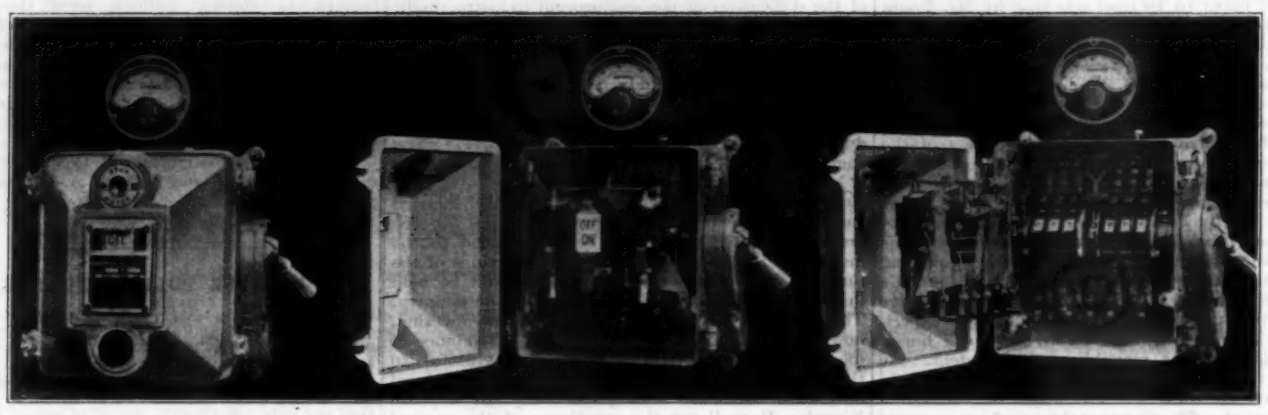
NEW ALTERNATING-CURRENT SWITCHGEAR

BROOKHURST SWITCHGEAR, LTD., CHESTER, ENGINEERS

(*For description see opposite page*)



FIGS. 1, 2 AND 3—"STRAIGHT ON" INDUCTION MOTOR STARTERS



FIGS. 4, 5 AND 6—"STAR-DELTA" INDUCTION MOTOR STARTERS

Congress of Chemists.

THE forty-fifth annual meeting and Congress of Chemists, in which the following Societies are co-operating:—Chemical Society, Institute of Chemistry, Association of British Chemical Manufacturers, British Association of Chemists, British Chemical Plant Manufacturers' Association, Bio-chemical Society, Coke Oven Managers' Association, Institute of Brewing, Institute of Metals, Institution of the Rubber Industry, Institution of Chemical Engineers, Institution of Petroleum Technologists, Oil and Colour Chemists' Association, Society of Leather Trades' Chemists, Society of Public Analysts, and the Chemical Industry Club—is to be held in London, July 19th to 23rd, next.

The following programme of arrangements has been drawn up:—On Monday, July 19th, at 10 a.m., the fourth annual corporate meeting of the Institution of Chemical Engineers will be held at the Central Hall, Committee Room D, Westminster, when the presidental address will be delivered by Sir Frederic L. Nathan, K.B.E., on "Industrial Efficiency and the Elimination of Waste." At 11.30 a.m. an Exhibition of Chemical Plant will be opened at the Central Hall, Westminster, by Sir Max Muspratt, Bart., President of the Federation of British Industries. The Exhibition is being arranged by the British Chemical Plant Manufacturers' Association. In the afternoon at 2.30 p.m., at the Mansion House, in the presence of H.R.H. the Duke of York, the Lord Mayor, Sir William R. Pryke, presiding, the Society's Messel Medal will be presented to the Earl of Balfour, O.M., F.R.S., who will thereafter deliver the Messel Memorial Lecture. At 6.30 for 7 p.m., the annual dinner of the Institution of Chemical Engineers will be held in the Empire Room, Hotel Great Central; and at 8.15 p.m. there will be a reception by the President of the Society of Chemical Industry, Mr. W. J. U. Woolcock, in the Winter Garden, Hotel Great Central, which will be followed at 9 p.m. by a smoking concert in the Wharncliffe Rooms, Hotel Great Central.

On the Tuesday, at 9.30 a.m., there will be a meeting of the Council of the Society of Chemical Industry in the Red Room, Hotel Great Central, which will be followed at 10 a.m. by the annual meeting of the Society of Chemical Industry in the Marylebone Room, Hotel Great Central, when Mr. W. J. U. Woolcock will deliver his presidential address. At 10.30 a.m. there will be a joint meeting of the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers, and the Chemical Engineering Group for a Symposium on "Corrosion," in the Empire Room, Hotel Great Central, when the following papers will be read by:—(1) Mr. Ulick R. Evans, "Fundamental Principles of Corrosion"; (2) Mr. W. H. Hatfield, "Chemically Resistant Steels for Chemical Engineering"; (3) Mr. P. Parrish, "Corrosion and Erosion"; and (4) Mr. R. J. Sarjent. At 11 a.m. there will be a joint meeting of the Bio-Chemical Society with the London Section of the Society of Chemical Industry in the Regent Room, Hotel Great Central. The subject to be discussed will be "The Scientific and Industrial Problems Presented by the Hormones—the Natural Drugs of the Body." The following papers will be read by:—(1) Dr. H. H. Dale, C.B.E., Sec. R.S., "The Experimental Study and Use of Hormones"; (2) Dr. H. W. Dudley, "The Chemistry of the Pituitary Gland and of Insulin"; (3) Mr. F. H. Carr, C.B.E., "The Commercial Production of Hormones"; (4) Dr. H. A. D. Jowett, "The History of Adrenaline"; (5) Professor G. Barger, F.R.S., "Recent Progress in the Chemistry of Thyroxine"; and (6) Dr. J. W. Trevan, "Biological Assay of Hormones." 1.15 for 1.30 p.m., luncheon will be taken in the Winter Garden, Hotel Great Central, by invitation of the London Section of the Society of Chemical Industry. In the afternoon, at 2.30 p.m., the annual meeting of the British Chemical Plant Manufacturers' Association will be held at 166, Piccadilly, W. 1. At 3 p.m. a discussion on "Chemistry House" will be opened by Dr. Stephen Miall. This meeting, arranged by the British Association of Chemists, will be held in the Marylebone Room, Hotel Great Central, and is open to members of any of the Societies. From 4 to 6 p.m. there will be a garden party at the Royal Botanic Gardens, Regent's Park, N.W. 1, by invitation of Sir Alfred and Lady Mond. At 6.30 for 7 p.m. the annual dinner of the British Chemical Plant Manufacturers' Association will be held at the Hotel Great Central, which will be followed at 8.30 p.m. by a reception in the Winter Garden and dance in the Wharncliffe Rooms.

On the Wednesday, at 10.30 a.m., the annual meeting of the Society of Chemical Industry will be held in the Marylebone Room, Hotel Great Central, when addresses will be given by Sir Josiah Stamp, G.B.E., and Sir Max Muspratt, Bart. In the afternoon there will be the following alternative visits to works and laboratories:—(*a*) General Electric Company, Ltd. (Osram Robertson Lamp Works), Hammersmith; (*b*) Watney, Combe, Reid and Co., Mortlake; (*c*) Bryant and May, Ltd., Bow, E.; (*d*) Research Laboratory of the British Rubber and Tire Manufacturers, Croydon; (*e*) Research Station, The Anglo-Persian Oil Company, Sunbury; (*f*) Whitbread's Brewery, Chiswell-street, E.C. 1; (*g*) London Wholesale Dairies, Harrow-road; and (*h*) Naylor Brothers, Ltd., Paint Works, Slough. For this day, also, a whole day char-a-banc drive through Surrey has been arranged for the ladies. The places visited will include Ockham, Ripley, Newlands Corner, Leith Hill, Ockley and Dorking. At 7.30 p.m. there will be a reception by the President of the Society of Chemical Industry in the Winter Garden, Hotel Great Central, which will be followed at 8 p.m. by the annual dinner of the Society of Chemical Industry in the Wharncliffe Rooms, Hotel Great Central.

On the Thursday, at 10.30 a.m., the annual meeting of the Society of Chemical Industry will be held in the Marylebone Room, Hotel Great Central. It will be followed by a joint meeting arranged by the Chemical Engineering Group with the Institution of Petroleum Technologists, and the Institution of Chemical Engineers on "Power Alcohol." Papers will be read by:—(1) Dr. W. R. Ormandy, "Sugar from Wood"; and (2) Mr. Douglas Ross and Dr. W. R. Ormandy, "Experiences with Alcohol Motor Fuels." At 10.30 a.m. there will also be a joint meeting of the Institution of the Rubber Industry and the Oil and Colour Chemists' Association, in the Regent Room, Hotel Great Central. The subject to be discussed is "The Influence of Particle Size in the Paint and Rubber Industries," and the discussion will be opened by Dr. D. F. Twiss (Rubber Industry), and by Dr. H. Houlston Morgan and Mr. C. A. Klein (Paint Industry). In the afternoon alternative visits to the following works and laboratories have been arranged:—(*a*) National Physical Laboratory, Teddington; (*b*) Burroughs, Wellcome and Co., Chemical Works, Dartford; (*c*) British Drug Houses, Ltd., City-road, N. 1; (*d*) Chemical Laboratories and Physics Laboratory of the Imperial College of Science and Technology, South Kensington, S.W. 7; (*e*) Chemical Laboratories, University College, Gower-street, W.C. 1; (*f*) Fuel Research Station, East Greenwich; and (*g*) Re-

search Laboratories and Glass Works of the General Electric Comapny, Ltd., Wembley. In the evening there is is to be a Conversazione, particulars of which will be announced later.

On Friday, July 23rd, there will be a whole day excursion to Reading. The works of Huntley and Palmers, Ltd., will be visited, luncheon and tea being provided by invitation of the directors. The day's programme includes a trip on the Thames, and dinner will be taken at Skindles Hotel, Maidenhead. On the same day, at 10.30 a.m., there will be a meeting in the Marylebone Room, Hotel Great Central, arranged by the Institution of Chemical Engineers and the Oil and Colour Chemists' Association, for discussion on "Fat Extraction by Solvents." A paper on this subject by Mr. L. J. Simon and Professor J. W. Hinchley will be read. Starting at the same time there will also be a meeting of the Fuel Section in the Empire Room, Hotel Great Central, when a summary of the Symposia at Leeds and Sheffield on "Solid Smokeless Fuel," will be given by Dr. E. W. Smith. In the afternoon there will be a launch trip from Westminster to Greenwich, tea being served on the return journey. A visit will be made to East Ham for inspection of the new Fat Extraction Plant described at the morning meeting.

New Alternating-Current Switchgear.

SOME new alternating-current hand-operated switchgear for the control of motors has recently been brought to our notice by Brookhirst Switchgear, Ltd., of Northgate Works, Chester. The company's new small power alternating-current gear is of the air break type, and whilst it is simple and compact it includes all the protective devices which are usually considered desirable for low power work.

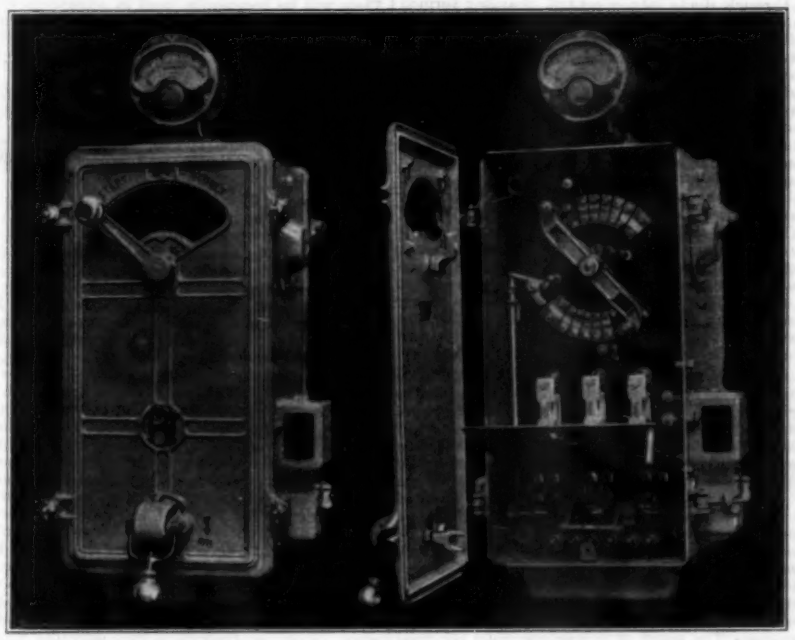
The "ASO 10" type "straight on" starter—see Fig. 1, page 646—consists of a three-pole quick make and break rotary starting switch, with a no-volt release, and three-pole double fuses, in combination with a three-pole paralleling switch. The gear is operated by a single movement of the handle, which closes the starter and parallels the two sections of each fuse. After a reasonable amount of time has been allowed for the motor to accelerate the handle is released, when the fuse paralleling switch opens and leaves only one section of each fuse in circuit. Protection is thus secured against short-circuits during acceleration and against ordinary excess currents under running conditions. The starter is provided with a no-volt release and a push button release—to be seen in Fig. 2.

The company's star-delta starters, types ASD 10 and ASD 20, are made either with fuses or with overload trip protection. In the former case—see Fig. 3—the starter consists of a double drum arrangement, comprising a triple pole quick-break circuit breaker with no-volt release, a triple pole star-delta starting switch, with the addition of triple pole double fuses and paralleling switch, the operation being the same as in the case of the straight on starter. The starter and circuit breaker drums are interlocked, so that the starter cannot be moved backwards from the delta to star position, it being essential to trip the circuit breaker before a fresh start can be made. The makers direct attention in the case of both the foregoing switches to the method of assembling the no-volt release and mechanism in the swing door.

The star-delta starter, type "ASD 20"—shown in Fig. 4—gives, when fitted with overload trips, excess current protection in the run position only. This starter comprises a triple pole quick-break circuit breaker, with no-volt and two overload releases, a triple pole star-delta starting switch, and a triple pole overload short-circuiting switch. The operation of the gear is similar to that of the foregoing types, for the starter is operated by a single movement of the handle, which closes the starting switch and short-circuits the overload trips. After a proper period of time has been allowed for the motor to accelerate, the handle is released and the overload short-circuiting device opens and introduces the overload trips into the circuit. In this case the no-volt and overload trips have been placed upon a hinged frame in front of the switching mechanism—as shown in Figs. 5 and 6—an arrangement which reduces the overall dimensions and at the same time gives great accessibility, both as regards the trips and the tripping mechanism and the starter itself.

The rotor starting panel, type A R—shown in Figs. 7 and 8—comprises a rotor starter of the face plate type, triple-pole fuses and a combined triple-pole stator switch and isolator. The stator switch is interlocked with the starter, so that the motor cannot be accidentally started without the full rotor resistance being placed in circuit. It is also enclosed in an inner chamber inside the main case, and is interlocked with the door in such a way that the switch must be "off" when the door is open, thus making accidental contact with the live parts impossible. All the units can be fitted with an ammeter if required

The horse-power limits of the various control gears described above are as follows:—The "A.S.O." type air break starter with fuses, 5 horse-power at 200 volts; the "A.S.D. 10" type air break star-delta starter with fuses, 8 horse-power at 200 volts; the "A.S.D. 20" type air break star-delta starter with overload trips, 8 horse-power at 200 volts; and the "A.R." air break rotor starter panel, 1–6 horse-power at 200 volts.



FIGS. 7 AND 8—ROTOR STARTING PANEL

Applications of Engineering to Agriculture.*

By FRANK AYTON, Ipswich.

Historical.—The oldest of the world's industries, agriculture, was among the first to enlist the aid of the engineer in carrying out more speedily, efficiently and economically the various operations concerned with cultivating the land, gathering the crops, preparing the produce for the market, and doing the host of other things which are part of, or incidental to, farming.

The most important operation in agriculture is that of ploughing the land and its subsequent cultivation. Early ploughs were of a crude type, the most primitive being entirely of wood. Wrought iron ploughshares or points were, however, used many centuries before the Christian era by the Romans and the Persians. Up to the year 1785 ploughshares were made in wrought iron, but in that year a patented process of making and hardening shares in cast iron was introduced, to be followed in 1803 by a method—Ransome's patent—by which the underside of the cast iron share was chilled. The year 1808 witnessed a further and notable advance in the design of the plough, which had up to that time not been constructed in such a way as to facilitate easy replacement of parts in the field. The new designs introduced overcame this difficulty.

Modern ploughs are constructed in a great variety of types for haulage by animals and others for use with mechanical power, and for various classes of work, such as ordinary ploughing, sub-soiling, ridging, draining, &c. For ordinary ploughing they are made to turn a single furrow or two or more furrows at a time. In Africa and certain other parts of the world, where very dry conditions are met with and where the surface of the land is baked into a hard crust, another type of plough is frequently used, known as the "disc" plough. Each furrow is turned by a revolving disc of saucer shape, with a sharp cutting edge, the plane of the disc being set at an obtuse angle to the surface of the ground and at an angle in relation to the direction of ploughing.

In tilling virgin land in overseas countries tree stumps and hidden rock are frequently met with, which would tend to break a plough of the ordinary type. Special designs in the form of "Stump-Jump" ploughs, for withstanding such conditions, are in considerable vogue in Australia. These are both of the "mouldboard" and "disc" types, so constructed that when meeting a buried rock or tree stump, the plough body or disc will automatically climb or slide over the obstacle and enter into work again without damage to itself.

For reducing the adhesion of sticky soils and lightening the draught of the plough, many ploughs are now fitted with mouldboards of a hardened special steel, having a highly polished glass-hard surface. With mouldboards of this type a cleaner turnover of the furrow is also obtained. Mouldboards made from "stainless" steel would appear to offer advantages, but at the present time this material is too costly to employ for this purpose.

Steam Ploughing.—Mr. J. T. Osborne, in 1848, demonstrated the haulage of a plough backwards and forwards across a field by means of an endless rope and steam-driven windlass. To Mr. John Fowler, of Leeds, belongs the credit of introducing the first really practical system of steam ploughing. His first attempt, however, was concerned with land drainage, the plant being designed to draw a mole-draining plough by cable. This system was demonstrated before the Royal Agricultural Society at its Carlisle Show in 1855. It was not until 1856, however, that at the Royal Agricultural Show at Chelmsford, Mr. Fowler was able to exhibit a practical steam-ploughing equipment. In 1858 his efforts were rewarded by winning the £500 prize offered by the Royal Agricultural Society of England for the best application of steam power to the land. In all the early steam-ploughing tackles only one engine was used. The method was known as the "Round-about" system, the engine being fitted with double drums, the rope from one drum being connected direct to the plough, and serving to haul it across the field towards the engine, the rope from the other drum being taken to a snatch block placed in an opposite corner of the field, and thence to a movable anchor carriage positioned on the opposite side of the field to the engine. The rope worked round a pulley on the carriage mentioned, and was attached to the other side of the plough, serving to haul it in the direction away from the engine.

Double-engine System.—The "Round-about" tackles, while doing satisfactory work, were quickly displaced when Mr. John Fowler, between 1860 and 1862, introduced his improved double-engine system, in connection with which the rope from the drum on each engine is attached to the plough, the engines alternately pulling the plough across the field one way or the other. The length of rope usually provided on each drum is 450 yards, but engines have been supplied with ropes up to 600 yards in length. The engines of modern steam-ploughing tackles are usually of the compound type, working at 180 lb. pressure per square inch. They are built to work with various fuels—for example, coal, oil, straw and other waste material.

In connection with cable ploughing, the latest development has been the employment of four-cylinder oil engines in place of steam for driving the capstans. These plants are made by Messrs. J. and H. McLaren, as also by Messrs. Fowler. A feature of Messrs. McLaren's plant is the provision of a self-starting device. When the plough has almost reached the end of its haul across the field by one engine, the motion of the idle rope, which is being pulled off the drum of the other engine, is brought into play to restart the engine. With this class of tackle a drawbar pull can be obtained on the rope almost equal to the actual weight of the engine.

Ploughing by Direct Traction.—Passing now to the subject of ploughing by direct traction, this system had been employed abroad for a number of years prior to the war, steam traction engines being generally used which hauled multi-furrow ploughs, some of them cutting as many as twenty furrows at one time, or even more. In this country the direct traction system came into prominent use during the war with the advent of petrol-paraffin farm tractors of 20–30 horse-power, which haul ploughs cutting two or three furrows. The earlier tractors gave a good deal of trouble, mainly through heavy wear and tear caused by gears and driving chains being exposed to dust and dirt and to the absence of any provision for preventing dust making its way into the cylinders through the induction pipe. Enclosed dust-tight gears and bearings, and the provision of an air filter on the carburetter intake, have overcome these drawbacks. The machines as now built are reliable, and reasonably economical in operation.

The greater speed at which farm work can be dealt with by a tractor, as compared with horses, is a feature of value to the farmer, who has to take advantage of every spell of suitable weather in order to get through his tilling and harvesting work in the time available. It must be remembered, however, that tractors can only work satisfactorily on the land when it is in a fairly dry condition.

Chain Track Tractor.—A type of tractor which is employed to a limited but increasing extent is that known as the caterpillar or chain track type, the pressure per unit of area upon the land surface due to the weight of the machine being comparatively low, owing to the large contact area of the track system. The adhesion is also much greater in relation to the weight of the machine, so that the latter can usually exert a draw bar pull equal to its weight. The heavy wear and tear on the chain track mechanism is, however, somewhat of a drawback to the employment of this type of tractor as compared with the wheel type.

Electric Power for Ploughing.—On the Continent, particularly in France, Germany and Italy, electric power is in some instances being applied to ploughing by means of cable haulage. It is, of course, a matter of no real difficulty to substitute for a steam engine or an oil engine an electric motor for the purpose of driving a cable winding drum. The question is whether there are such advantages over the steam or oil engine plants as will offset the trouble and expense of erecting overhead supply lines to the different arable fields on a farm, assuming, of course, that the farm is in such a position that it can command a supply of electrical energy from some public transmission system. It has to be remembered that most of the steam-ploughing tackles are worked by contractors who go from farm to farm, and it is not likely that, until all farms in a neighbourhood are electrified and provided with supply connections to the different fields, the ploughing contractor will look with favour upon a type of plant which, even though in cost of operation comparing favourably with steam or oil, has to depend upon some other means than electricity to haul it from place to place. The difficulty of haulage has, in some cases, been overcome by the provision of a separate oil engine, but all this is complication

* The Institution of Mechanical Engineers—Ipswich meeting—condensed.

which makes the comparison unfavourable with the completely mobile and very handy steam and oil engine ploughing tackles.

Alternative Methods of Power Tillage.—From time to time machines have been invented and constructed to supersede the plough as a means of tilling the soil. Thus the steam digger, imitating the use of the spade, had a meteoric career. In recent years machines of another type have been introduced. A prominent one of this type is of Swiss origin—the "Simar rotary tiller," which has a rotating shaft at the back, on which are mounted renewable spring tines of a quickly replaceable type. This shaft is driven by an internal combustion engine. The tines are forced into the soil, breaking it up and throwing it out behind, thoroughly aerating it in the process.

Land Drainage.—A subject which is receiving a good deal of attention at the present time is that of the drainage of heavy agricultural land. The use of steam cable ploughing engines for this purpose enables the work to be carried out at a cost much below that at which drains can be laid by manual labour. The system referred to entails the use of a special mole-draining plough, which consists of a carriage carrying a vertical cutting blade, to the lower part of which is attached the mole. The latter is a cylindrical piece of steel with a nose specially shaped to facilitate its passage through the subsoil, and to enable it to leave behind it a smooth drainage duct. In certain subsoils a second piece of steel, shaped like an elongated egg, is dragged by a link behind the mole, and being a little larger in diameter than the latter, serves to smooth and consolidate the wall of the duct. The ducts are from 3in. to 4in. diameter. In arable land the drains have to be made at a depth of not less than 24in. as a rule, otherwise the horses working the land would, by reason of their weight, cause the ducts to fall in. Sometimes the ducts are made at a depth as great as 36in. Messrs. Fowler have lately brought out a machine for pushing tile drains—earthenware pipes—into the ducts formed by the mole-drain plough. The machine requires the provision of access holes along the line of the duct at from 60 to 100 yards apart.

Harvesting Machines.—In connection with machines used for harvesting, the reaper and binder stands out as one which not only combines remarkable ingenuity in its construction, but is of such value as a labour-saving appliance that were it not available to-day the cost of wheat throughout the world would, undoubtedly, be higher than it is. The reciprocating "V"-shaped blades, arranged in succession along a carrying bar, which with the fixed fingers form the cutting mechanism of the modern reaper and binder, as also of the grass cutter or mower, was the invention of an American, Cyrus H. McCormick, who brought into use his first machine on his father's farm in Virginia in 1831, when he was but twenty-two years of age. This first machine was merely a mower or reaper. It was not until 1874 that Withington, another American, having invented a binding mechanism, became associated with McCormick, with the result that the complete reaping and binding machine was introduced. The binding was done with wire, which was not altogether a suitable material for the purpose. In 1880, however, William Deering, another American, brought out machines which bound the sheaves with twine—this was a notable improvement.

A later development of the machine just described is the "harvester thrasher." This machine in one form is a combination of a reaper and a simple type of thrashing machine. It carries a petrol engine for driving the thrasher, but the reaping knife, which in this case only cuts off the grain-carrying heads from the crop, is driven from a large land wheel of the machine. In operation a wagon is kept moving alongside the machine, and into it the grain is delivered as it comes from the thrashing machine. In another form of harvester thrasher, which is used mainly in Australia, the corn is gathered by means of hollow fingers which comb off the heads, the grain being collected in the hollows of the fingers.

Beet Sugar Cultivation.—The Government subsidy on home-made beet sugar has served to make the growing of sugar beet a paying proposition. The usual contract between the farmer and the factory stipulates, among other things, that about 2in. of the upper portion of each beet is to be cut off before delivery to the factory, whilst the beet has also to be freed from adhering soil. The long tap root must, however, be left intact. Lifting and topping the beet is therefore one of the expensive operations concerned with growing this crop. In the ordinary way it is done by loosening the surrounding soil by the use of a special kind of plough which is run alongside the row of beet, the plough having a side projecting share which lifts the soil in which the beet is growing. The beets are then lifted, cleaned and topped by hand. Attempts have been made to devise machines which will not only raise the beets, but will also automatically top and clean them. Any machine to do this must, of necessity, be complicated and expensive, and if the latter there will, under present conditions in this country, be but few willing to purchase it. So far the machines which have been brought out for this purpose have not worked successfully, owing to the widely varying conditions of the crops and of the soils in which they are grown.

Thrashing Machines.—With the exception perhaps of the reaper and binder, the most interesting, and at the same time complex, machine which the farmer uses is the thrasher. The earliest designs of thrasher of which there is record, namely, the machines of Michael Menzies and Jethro Tull, built in 1770, sought to imitate as closely as possible the action of the flail. These machines, however, were crude affairs, and were turned by manual or animal power. The first machine to bear any resemblance to the modern machine in respect of having a revolving thrashing drum, was that of Andrew Meikle, produced at the commencement of the nineteenth century.

The general design of thrashing machines has undergone little change in recent years, such alterations as have been made having been concerned with simplification in detail design from the point of view of more economic manufacture and other details making for the lightening of moving parts, and the reduction of friction by the fitting of ball bearings. These changes have in the main been brought about since the war, and their effect upon the output considered in relation to the power input has been noteworthy. Pre-war types of thrasher gave an output of approximately 200 lb. of wheat per brake horse-power hour, whereas recent designs yield, even in the case of small machines, about 250 lb. per brake horse-power hour.

Thrashing Drums.—The actual thrashing—or, in other words, the extraction of the grain from the ear of the corn—is done by the thrashing drum revolving at high speed in a cage partly encircling the drum, which is called the "concave." Thrashing drums are made in two types, namely, the beater drum and the peg drum. The first-mentioned type carries diagonally fluted bars mounted axially on discs or spiders, and the drum rotates in the "concave." The grain falls through the spaces between the steel bars of the concave, after being knocked out by the impact and stripping action on the grain ears as they are swept round in the confined space between the concave and the rapidly rotating drum. In the case of the peg drum, lines of specially shaped steel pegs take the place of the beater bars, and the concave, instead of being a plain cage, is a frame carrying lines of similar steel pegs pointing towards the centre of the drum, and so disposed that the drum pegs move in between the fixed pegs of the cage.

The differences between the working of the two types of drum is that, while for given dimensions a greater quantity of crop can be put through the peg drum machine than in the case of the beater drum machine, it delivers the straw in a mangled or broken condition. In the countries where a peg drum machine is employed, this is not a disadvantage, because the straw is often burnt as valueless or is used for cattle feeding. To bring it to the necessary fineness for this latter purpose, a special straw-chopping and bruising apparatus can be fitted to either peg drum or beater drum thrashers.

Drying of Crops.—Artificial drying of crops for the purpose of rendering harvesting operations as far as possible independent of the weather is not a new idea, the use of a power-driven fan for this purpose having been tried in the 'eighties, but at that time no headway was made in the general application of the method. Recently, however, the idea has again come to the fore, Dr. B. J. Owen, of the Institute of Agricultural Engineering in the University of Oxford, in conjunction with Mr. C. Tinker, having introduced a system by which heated air is blown by a fan through ducts into a central chamber formed inside the stack. It is claimed that a crop cut in the usual way, if left for a period not exceeding twenty-four hours, may be stacked and, after blowing hot air through it for eight hours, is usually dry. In the case of hay, the rapid removal of the moisture is said to prevent any chemical change from taking place, in consequence of which there is no loss of nutriment.

A rival system is that employed at the present time by Mr. Borlase Matthews, an engineer who has taken to farming, and who employs an unheated supply of air forced through the stack by a fan. This system was originally introduced by a well-known mining engineer, Mr. W. W. Hood, in 1920, and in connection with it fermentation is allowed to take place while the drying out operation is proceeding. Mr. Matthews claims superior results in the feeding value of hay made according to this method, but time will show which method is the best and whether the artificial drying of crops is an economic proposition for the farmer. At the present time there is a little uncertainty and much contention ranging round the subject.

Portable Steam Engines.—While it is perhaps a little difficult to decide as to who brought out the first portable steam engine, it is of interest to note that in regard to an engine exhibited by Ransomes at the Royal Agricultural Society of England meeting at Liverpool in 1841, the Society reported: "To Messrs. Ransome, of Ipswich, the Society is indebted for what may be termed the great novelty of the meeting. We believe this is the first attempt to render steam power portable." The report adds that the engine "appears to have worked well." It may be added that at the next meeting of the Society, a similar engine was exhibited, mounted on four wheels—previously it was on two—with a chain drive from the crank shaft to the hind wheel axle, thus becoming the first self-moving engine, the precursor of the road locomotive or traction engine. The speed of this engine upon the road was four to six miles per hour.

Apparently at one time there was doubt in the minds of some people as to the extent to which the portable steam engine would be employed, for in THE ENGINEER of June 27th, 1879, it was stated that Messrs. Howden built twelve engines, and then gave up making more fearing that the country would become overstocked!*

Steam Pressures.—From 1839 to about 1860 the working steam pressure of portable engines varied from 40 lb. to 45 lb. per square inch. In 1861 it had risen to 60 lb., and in 1867 a working pressure of 100 lb. per square inch appears to have been tried. At the trials at the Royal Society's Show at Cardiff in 1872, however, the general working pressure was only 80 lb. per square inch. Working pressures have steadily advanced since that time, namely, 90 lb. was a usual figure in 1890, while to-day 150 lb. per square inch is the pressure employed in some of the latest single-cylinder high-pressure engines. During late years the oil engine has become a powerful competitor of the steam engine, and this competition caused some of the principal continental manufacturers of portable engines to bring out engines working with superheated steam and fitted with piston valves. These engines were constructed for working pressures of 180 lb. to 200 lb. per square inch.

Piston Valve Engines.—In the past portable engines have usually been fitted with ordinary slide valves, but with the increase in working pressure several makers have brought out engines fitted with piston valves. It is interesting, however, to note that these newer type engines with piston valves are not favoured in all countries. There is still a preference in some cases for the older form of slide valve which is well understood, and may be repaired fairly easily, even in remote districts. The higher boiler pressures render the use of the piston valve almost a necessity, and no doubt that particular design will progressively come into general use in the future.

Portable engines were originally built with one cylinder; after a not very long interval also with two cylinders, and later also as compound engines. They are fitted with feed heaters and frequently with automatic expansion gear. The single-cylinder engine is that which is most usually employed in agricultural work. Until about 1876 portable engines appear to have depended for fuel on only coal or wood, but in the year mentioned the invention of a straw-burning apparatus by Mr. John Head, of Messrs. Ransomes, in conjunction with a Russian engineer, Mr. Schemioth, enabled straw to be used as fuel in a very simple and efficient manner.

Except in countries or places where very cheap or waste fuel, such as wood, straw, bagasse, maize cobs, &c., is available, it has to be admitted that the oil engine has largely superseded the steam engine, except for the driving of large thrashing machines and for hauling the latter, in which connection the steam engine is still almost universally employed. But for general purposes about the farm in this country, and in other countries where there is no cheap or inferior fuel to be had for steam engines, the oil engine is undoubtedly the favourite prime mover, and in the small sizes is, without question, a most useful aid to the farmer in driving the various machines in and about the farm buildings. Most of these small oil engines are of the petrol-paraffin type with electric ignition, although there are numbers of engines used on farms which are of the hot-bulb type.

Electrification.—In parts of the country public electric supply mains have already been carried into rural districts from existing urban power stations. If the Electricity Bill now before Parliament reaches the Statute Book in more or less its present form, increasing development in this direction may be expected, since rural electrification is an aim covered by one of the provisions of the Bill. In the areas where rural electrification has already been dealt with, a fair number of farms are using electric power in the form of stationary or portable motors for driving various machines in use in and about the farm buildings—for example, dairy plant, as also grinding mills, chaff cutters and similar machines. The cleanliness of this means of driving, as also the ease of starting and stopping, are likely to make a strong appeal to the farmer, whilst he will also no doubt appreciate the advantages of electric lighting. Motors for farm purposes must, however, be of suitable design and capable of withstanding fairly rough usage. They will be frequently used in situations where in the ordinary course of working they will be smothered in dirt and dust, and in certain positions subjected to the corrosive effect of urine. The requirements of the farm cover motors of both the stationary and portable types, the latter being usually provided with reduction gears which enable them to be belted direct to the machines which are to be driven. Alternating-current induction motors are destined to become the standard for this work, since distribution in rural areas will be carried out on the single or three-phase alternating-current system.

Mechanical Milking.—Among interesting mechanical developments on the farm is the mechanical milking of cows. It is not a difficult thing to devise a mechanism which will draw the milk from the cow, but it is far otherwise when it comes to designing an apparatus which, by closely following the natural process of the calf milking the cow, will avoid injury to the udder or teats. Beyond this difficulty there are others, as, for example, the necessity for the apparatus to withstand boiling water, and the fact that though the apparatus may be right in principle, its working may not please or humour the cow. The cow cannot be forced to give her milk, she has to be humoured. Nevertheless, these difficulties have been overcome, and there are reliable machines on the market. The machines consist of a vacuum pump working in conjunction with a pulsating valve, which may be combined with the pump, as it is in one make, or with each teat cup, as in another make. The teat cup contains a flexible rubber liner, which, working under the influence of the pulsating valve and the vacuum provided by the pump, draws the milk from the teat, at the same time massaging the teat and promoting a correct circulation of blood. One of the difficulties which is experienced in extending the use of milking machines in this country is due to the great lack of uniformity in the shapes and sizes of the teats of cross-bred cows. As a rule, there is no such difficulty with any pure-bred strain, because the teats are well defined and regular.

Seed Separation.—The provision of clean seed—that is, seed free from weed seed—is of great importance to the farmer. The problem of efficient separation is one which is full of difficulties, and very ingenious machines are used for this purpose. Mention may be made of one remarkable machine introduced during the last two years, which has solved a problem upon which many minds had previously concentrated without success. A parasitic weed—dodder—is often found growing with clover. The dodder seed is practically of the same size, shape and weight as the clover seed, only differing from the latter in that it has a rough surface as against the smooth polished surface of clover seed. All methods previously employed had failed to remove more than a small proportion of the dodder seed. The Bedell patent process of seed separation, however, achieves the removal of the whole of this seed. The untreated seed is first mixed with a powder which is capable of being attracted to a magnet. The powder adheres to the rough surface of the dodder seed, but the clover seed, by reason of its smooth surface, remains free of the powder. The seed is carried by a conveyor under some magnets, and by the influence of the magnetism the dodder seed, coated with the powder, is lifted from the mass of clover seed, which is carried on by the conveyor and delivered into a receptacle.

General.—We have reached a stage when it may be said that engineering is indeed the handmaid of agriculture, for by her aid the farmer ploughs and prepares his seed bed, sows his corn, weeds the growing crop, reaps it, thrashes it and transports it to market. Little imagination is needed to realise that we should be a half-starved and miserable community, unable to extract from the earth the full tribute which it is capable of rendering, if to-day the world had to depend on the rude implements of our ancestors for cultivation of the land and gathering of crops instead of the aid which has been given by the engineer in providing the machinery and implements which now are in common use on all up-to-date farms.

* Reference to the issue named shows that the date on which Messrs. Howden, of Boston, came to this conclusion was some time in the early 'forties.—ED. THE E.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

COAL AND ECONOMICS.

SIR,—In discussing "Coal and Economics" you and your correspondent make no allusion to the part of the problem which most demands the attention of the engineer; that is, appliances to make possible the payment of the not too extravagant wage asked by the collier, and at the same time increase the profit of the colliery owner and reduce the selling price of coal to the consumer. The higher standard of living now than in the past is almost wholly due to the inventor of labour-helping machinery and organisation. Now it seems a still higher standard is demanded without such aid; but whether "economic" or "human," no one can deny there is a "law," or something, which prevents us in the aggregate and long run having or consuming more than is produced. So I think the engineer should devote all his energy to increasing production, and leave politicians to quarrel over the proper distribution of that produce.

Our great industrial position was not founded upon lower-paid, but upon more productive, labour, than that of our competitors. Now that other countries are as well or better equipped, we must either be beaten in competition or pay labour less, if we do not revert to our old policy of increasing its comparative efficiency; and the engineer should show how this can be done.

It seems strange that this better educated generation should lack the inventive and enterprising spirit by which its forefathers gained such a dominant position in industry. We have still the wealthy speculator and the imaginative inventor, but they are of little use unless or until combined; moreover, the speculator now prefers the guidance of the "expert." The latter, like the "practical man," is well enough in his place, but that is not in pioneer work, or in new departures. The one may thoroughly understand how a particular thing is done, and the other, without much understanding, be well able to do it; but what is wanted is not knowledge of how it is done, but of how it should be done. Applying this generalisation to the immediate question we are concerned with, we do not require either the educated "expert" or the experienced "practical man" to show us how coal is got at a loss by paying inadequate wages and selling at high prices—we know that already.

What is wanted is the man with sufficient imagination to see and show how to get it with profit while paying good wages and selling at low prices. Such a man, however, would be met with ridicule instead of reason, unless he could practically demonstrate his scheme, and this is only within the power of the wealthy, who, as a rule, have had all their native imagination educated out of them. I write from experience, and believe this to be the chief cause of our comparative decline in industry. If the practical Englishman cannot stifle a new idea at its birth, he now stands sullenly by and only takes part in its evolution when it is nearly complete; then, I own, he works well, but this is not enough to regain the lost ground.

I have directed attention to this matter because it applies both to the coal question and the general industrial position, and is so often altogether overlooked.

ARTHUR OATES.

Bradford, June 14th.

BRITISH WATERWORKS ASSOCIATION.

THE summer meeting of the British Waterworks Association is this year to be held at Bristol from Wednesday, June 30th, to Friday, July 2nd, inclusive. The following programme has been arranged:—

On Wednesday morning, June 30th, at 11 a.m., there will be a meeting of the Executive Committee of the Association in the Lecture Theatre of the Museum and Art Gallery, Bristol, and at 12.45 p.m. a luncheon at the Royal Hotel, for the members of the Executive Committee, by invitation of the Bristol Waterworks Company. In the afternoon, at 2.15 p.m., the fifteenth annual general meeting and conference of the Association will be held in the Lecture Theatre of the Museum and Art Gallery, when the members will be welcomed by the Right Hon. the Lord Mayor. After the transaction of the usual business the new president will be inducted and deliver his opening address. Thereafter the following papers will be read and discussed:—"Consideration of Waterworks Pumping Plant," by Mr. John A. McPherson, M. Inst. C.E., Engineer, Bristol Waterworks Company; and "Roadside Water Supplies for Steam Wagons and Road Engines," by Mr. F. G. Bristow. In the evening, at 7 p.m., there will be a reception at the Victoria Rooms by the President, which will be followed at 7.30 p.m. by the annual dinner of the Association at the Victoria Rooms.

On the Thursday morning, at 10 a.m., the reading and discussion of papers at the Lecture Theatre of the Museum and Art Gallery will be resumed. The following papers will be presented:—"The Mendip Hills, their Geology, Caverns and Antiquities," by Mr. H. E. Balch; and "The Administration of a Waterworks Revenue Office," by Mr. W. H. Parsons, Chief Revenue Office, Secretary's Department, City of Birmingham Water Undertaking. In the afternoon there will be a visit to the Chelvey pumping station and the Barrow Gurney store reservoirs and filter beds, leaving at 2.30 p.m. In the evening, from 8.15 p.m. to 10.30 p.m., there will be a reception at the Clifton Zoological Gardens, by invitation of the Bristol Waterworks Company.

On Friday there is to be a visit to the Cheddar sources, pumping station and caves, and the Blagdon reservoir and pumping station, the start being made at 9.30 a.m. from the Royal Hotel. For Saturday the Mayor and Corporation of Bath have invited members to visit and inspect the historic Roman baths and the Corporation bathing establishment in the forenoon. Rowe Bros. and Co., Ltd., of City Lead Works, Canons' Marsh, Bristol, manufacturers of lead pipe and sheet lead, have also invited members to inspect their works.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Carrying On.

In spite of all the difficulties which beset iron and steelmasters and manufacturers generally, quite a number of them in the Midlands and Staffordshire, even in the heavier industries, contrive to keep going. The mills still at work generally utilise electric driving and gas heating. At some furnaces it is possible, with the aid of tar or oil mixtures, to make use of the inferior fuel gleaned from Staffordshire mounds, and some sheet rolling mills are able to take advantage of this residue to supplement their small fuel stocks. The iron and steel trades nevertheless are now feeling with great acuteness the shortage of coal, while engineering establishments and manufacturing works are feeling the scarcity of raw material. To-day's meeting of the Midland iron trade in Birmingham was poorly attended, and there was little change in the general position of the market. The amount of business transacted was proportionately negligible.

Midland Miners Return to Work.

During the past week there has been an undoubted improvement in the coal position in the Midland area. At many of the collieries where the owners have offered to open the pits at the same rates of wages as were in force when work ceased on May 1st, except that the hours worked shall be eight instead of seven, hundreds of miners have returned to work. At others where the wages and hours are the same as before the stoppage pending a national settlement similar conditions prevail. Over 1000 men of the Highley and Kinlet pits, near Bridgnorth, have resumed work on day-to-day contracts, subject to a national settlement. Though not affiliated with the Miners' Federation of Great Britain, these men came out during the national stoppage in May. These pits, under the Highley Mining Company, are the most important in the Severn Valley coalfield, which stretches from South Salop to Wyre Forest in Worcestershire. There are smaller collieries working at Mamble, Bayton, and Pensan, in the Bewdley area. At three collieries in the northern area of the Warwickshire coalfield numbers of men have returned to work. The most striking instance is that of Pooley Hall Colliery, Polesworth, where 542 workers have gone back since the stoppage, and, with the "safety" men, 695 are following their employment. They are on day-to-day contracts at the wages and hours in force before the stoppage, pending a settlement in the county. Up to Saturday, 83 men had returned to Tamworth Colliery, where there were also 100 safety men. At this pit, as well as at Pooley Hall Colliery, coal is being turned and distributed. At Kingsbury Colliery 71 men have gone back to work, and 123 safety men are on duty in addition. Men have resumed work at other pits in the Tamworth area, although at five of the eight pits the number is not appreciable, being only 23 all told, in addition to the safety men. In Nuneaton, Bedworth, and other parts of the Warwickshire coalfield, the men are solidly supporting their leaders. In the Cannock Chase area over 80 men have resumed at the Brereton collieries. They have met with a hostile reception from the men who are still on strike. At a meeting of miners' delegates of South Staffordshire and East Worcestershire it was resolved, in connection with an offer made by the Earl of Dudley's Baggeridge Colliery Company, Ltd., and other owners, that the men be ordered not to accept any terms which would mean a reduction in wages, an increase in hours, or a district settlement. As the days go on and no settlement is reached miners are becoming more and more dissatisfied with their leaders, and there are indications that in many portions of the Midland coalfields the men, tiring of inactivity and disappointed, will gradually drift back to work on terms which it is considered by many of the men, will form the basis of the final settlement.

Steel Business.

Business in steel, though of a restricted character, continues, and most classes are procurable in small quantities and at enhanced prices. Orders are still being received at the mills, and the liberal bookings over the past week—in some cases sufficient to occupy the mills for two months—when operations are resumed—point to the existence of a substantial steel demand. Moreover that much more work is pending is indicated by the steady flow of inquiries to constructional engineers, some of them involving good quantities of steel. Steel masters on 'Change in Birmingham to-day expressed more confidence as to prospective activity than has been the case for many weeks past. All that is now wanted, they say, is a return to work on the part of the miners. Steel values keep up their firmness. Angles and joists selling a short time ago at £7 2s. 6d. now realise prices varying from £7 10s. to £7 15s. In one instance to-day £7 17s. 6d. was quoted. Buyers of ship, bridge, and tank plates find it extremely difficult to get supplies even though premiums are willingly paid on the basis rate of £7 17s. 6d. The strike has had very little effect on Belgian quotations, but billets have advanced 1s. 6d. per ton to £5 6s. 6d. delivered. Prices of blooms, bars and sections remain stationary. Joists command about £6. Builders, usually preferring English steel, are now taking Belgian joists. Birmingham merchants increasingly order steel bars at £4 15s. f.o.b. Antwerp, in the execution of orders placed by foreign customers. This week there has been experienced a keen inquiry for tinplate wasters, and the price has advanced from 17s. 6d. to 19s. basis.

Pig Iron.

The Staffordshire iron trade is among those almost completely disabled, through lack of the essential coal. The number of operating blast-furnaces steadily diminishes. By way of exception a furnace in the neighbourhood of Dudley, which was stopped by the general strike and was then damped down, is again at work, producing cold blast iron for high class foundry work, and can continue for a few weeks longer. For all practical purposes, however, there is no output of pig iron. Several foundries are in difficulties, and are keenly seeking such small lots of pig iron as are available, but stocks at the furnaces are now nearly cleared, and preference is invariably given to regular customers, and to consumers having contracts with the furnaces. The iron obtainable realises an advance of something like 7s. 6d. per ton on pre-strike levels, but there has been no appreciable change on the week, Northamptonshire No. 3 commanding £3 10s., and Derbyshire up to £3 15s. per ton at furnaces. Some inferior or unsuitable brands are being bought which at ordinary times are a drug on the market, and are only used under compulsion. Foundry operations, it is feared, must steadily decrease. Scrap is plentiful. Durham coke and a certain amount of coal have likewise been available. East Coast hematite can still be bought at the rates prevailing before the strike, mixed numbers being round about £3 15s. at furnaces.

Staffordshire Iron Trade.

The Staffordshire finished iron trade is idle, this industry requiring good quality coal for puddling and mill purposes. Rather large quantities of German fuel have been the subject of negotiation, and are expected to be available shortly. The iron trade has exhausted its resources, or practically so, and will be out of action till fuel is forthcoming. Fortunately a considerable number of mills have taken up the re-rolling of steel, and many of these find work still possible, being able to utilise electrical energy. These exceptions are useful to various Birmingham industries utilising steel from the Staffordshire district. Increasing quantities of foreign semi-finished steel are used by re-rollers. The nut and bolt trade continues fairly active, and one or two concerns are introducing oil furnaces for heating. Producers of bars are able to get No. 3 bars from Belgium at about £6 2s. 6d., delivered in the Black Country. Tube makers continue operative, iron gas-tube strip finds a ready sale at £12 10s. per ton.

Sheet Values Appreciating.

A few sheet mills in the Black Country are still producing moderate quantities with the aid of residual fuel mixed with oil or tar. There is no lack of business available. Foreign inquiries keep up remarkably well, and substantial orders are being booked for delivery after the strike, at the increased price of £16 for 24-gauge galvanised corrugateds. Very few of the big mills now have stocks to draw upon, and sellers who can give immediate delivery have no difficulty in getting the increased price. Indeed, it is reported, in some instances, as much as £16 5s. has been conceded for 24-gauge sheets.

Birmingham Wire Trade.

The Birmingham wire mills continue to make fair production. They are still able to obtain a proportion of English wire rods. Belgian rods, however cheaply supplied, are being increasingly used. Larger quantities of finished wire are also being imported.

Scrap.

Steel scrap is practically unsaleable, and the refusal of deliveries on contracts continues to cause difficulty and loss to the merchants, especially in connection with railway charges.

Birmingham-Wolverhampton Road.

The construction of the new highway between Birmingham and Wolverhampton has now been carried to an advanced stage, and it is hoped that the road will be ready for traffic next year, probably towards the end of the summer. The highway has been cut through areas typical of the Black Country. Pit mounds and quarries have had to be levelled and consolidated to provide the even sweep of road suitable for the fast-moving traffic of the present day. Largely cut through an old mining district like this, it was inevitable that a variety of engineering problems should present themselves, in addition to the work of filling up depressions and of levelling pit banks. In several places old colliery shafts have been struck and have had to be filled in. The road crosses the railway at several points, and three new bridges, each with a 60ft. span, are in course of construction. The length of the new road, which will provide a means of rapid and direct communication between Birmingham and Wolverhampton, will be 9¾ miles. The carriageway at present under construction is 40ft. in width, and it can be extended, if necessary, to 80ft. The footpaths on either side are 10ft. in width.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

CONSIDERING the difficulties they are faced with in respect of supplies of fuel and also of steel materials, the engineering industries in the Lancashire area manage to keep going fairly well. Each week, however, the position becomes more serious. During the present week only up to 25 per cent. of the normal supplies of coal will be permitted to consumers in Lancashire and Cheshire, although the Coal Emergency Committee has called the attention of industrial users to the fact that coke is available and can be utilised, together with coal, in quantities which will enable industries to work up to 50 per cent. of their time. Both at Liverpool and Manchester attempts are being made to relieve the situation by means of foreign coal, and already substantial quantities have been imported. Whilst the engineering industries themselves have been less seriously affected, chiefly because most of them depend upon municipal electricity supplies for power, the effect on the iron and steel trades in the Manchester area may be gauged from the fact that about 90 per cent.

of the local members of the Iron and Steel Trades Confederation are unemployed, most of them since the commencement of the general strike at the beginning of May. The carriage and wagon works of the London, Midland and Scottish Railway at Newton Heath, and those of the London and North-Eastern Railway at Dukinfield are on short time. Shortage of materials is creating difficulty at the Birkenhead shipyards of Cammell Laird and Co. A useful order secured by this firm is for a 355ft. passenger vessel for the Liverpool–Douglas service, placed by the Isle of Man Steam Packet Company. The statement at Liverpool this week of Mr. E. W. Beatty, president of the C.P.R., that orders for five cargo and two passenger vessels, involving an expenditure of about £3,000,000, would be placed within the next few days, is welcome news, as it is certain that most of the programme will be carried out in British yards.

Non-ferrous Metals.

The past week has been a period of general steadiness in the non-ferrous metals market, in which tin, following a weak spell, has participated, that section of the market having recovered virtually the whole of the ground lost in the previous few weeks. To some extent the strengthening of tin is due to an improvement in the United States demand. For the same reason also the copper market continued its advance, and at the moment is decidedly firm, although a contributory influence perhaps, as I pointed out last week, may be the bullish effect of the new American Copper Export Association, which is expected to start operating within the next few weeks. Copper sheets, and copper, brass and condenser tubes remain on the same bases as have lately been ruling. Spelter, which for some time has been one of the steadiest sections of the market, shows continued firmness, and closed strong after registering a substantial advance on the week, a fair demand and a favourable position from the point of view of supplies exercising a marked influence. Quietly steady buying of lead has helped to stiffen values again, and at the time of writing the metal still displays firmness.

Iron.

So far as supplies are concerned, the position of the pig iron market is naturally becoming more serious, for stocks are being steadily cleared, and there is no possibility of additions being made to them whilst the mining stoppage goes on. As I have previously pointed out, most makers have withdrawn from the market, and are not quoting, Derbyshire, Lincolnshire and Staffordshire brands being more particularly affected in this respect. Occasionally one hears of odd lots of these brands coming on to the market, but they are small and are bringing good prices. All possible sources of supplies are apparently being gone over very carefully. From 85s. to 87s. 6d., and even 90s. are the prices that have been quoted on this market during the present week for small parcels of Derbyshire No. 3. For Scottish No. 3 limited supplies have been offered at prices up to 97s. 6d. and Cleveland at about 90s., with East and West Coast hematites at 90s. to 91s., including delivery into the Manchester area. Offers of small quantities of Middlesbrough No. 4 have been made at 89s. per ton. Lancashire Crown bars show no change at £11 per ton, delivered in the South Lancashire area, with second quality quoted at £9 15s. Inquiry for these irons during the past week has been less active, due apparently to users being compelled to curtail operations because of the fuel scarcity.

Steel.

Whilst many users of steel are managing to keep going to some extent, there are quite a number of important constructional jobs held up because of the exhaustion of supplies of heavy section material. Apart from the business passing in continental steels, the market is quite featureless so far as current transactions are concerned. With the accumulation of contract orders during the past seven weeks by most of the mills there is every likelihood of a spurt when things are normal again that will last for some time. Higher steel prices are being looked for when it is possible to secure a basis for a revised estimate of production costs. Because of the undesirability of further widening the margin between British and continental steels, the feeling is that makers are not likely to advance quotations to a greater extent than will be justified under the new conditions. In the meantime, fresh contract business is in abeyance, although I am told that some Scottish firms are booking orders for boiler plates for forward delivery at the pre-strike quotation of £11 per ton. Galvanised sheets are now up to £16 5s. per ton, f.o.b., for the usual Bombay and Calcutta specifications, although there is not much inquiry of importance just now. There is a steadier feeling in the market for continental steels, with steel bars quoted at £5 17s. 6d., sheet bars at £5 2s. 6d., Siemens plates at £6 7s. 6d., ordinary plates at £6 2s. 6d., joists at £5 12s. 6d., and sections at £5 17s. 6d. to £6, for net cash against shipping documents, and including delivery into this area.

Scrap.

There is very little demand for scrap of any description, and so far as the iron and steel varieties are concerned prices are purely nominal. Although quiet, scrap non-ferrous metals are steadier in sympathy with the new metals. For graded materials, delivered to users' works, lead scrap is now quoted at £29 per ton, zinc at £24 to £25, heavy copper at £60, braziery copper at about £50, selected gun-metal at £52 to £53, and selected heavy yellow brass at £45.

BARROW-IN-FURNESS.

Hematites.

There is no change to report this week in the position of the hematite pig iron trade of this district. What business is being done is on the part of ironfounders, who are taking some deliveries of iron from makers' stores. Their wants, however, are only moderate. No iron is being produced in the entire district from Carnforth to Maryport. Fair orders are held, but they cannot be filled until the coal stoppage is at an end and fuel supplies are again coming to hand.

Iron Ore.

The iron ore mines are mostly idle, but ore is being raised at Roan Head, near Barrow, and at Hodbarrow, in South Cumberland. There is no local demand. Nothing is being done in foreign ores just now.

Steel.

In the steel trade there is idleness at Barrow and at Workington in the producing plants and rail and other important mills, but at Barrow the rolling of hoops is maintained. Business in steel rails is at a standstill.

Shipbuilding and Engineering.

Activity is maintained in the shipbuilding and engineering trades, and progress is being made with the ships on the stocks. A considerable amount of work has been done in the fitting out of the British cruiser Cumberland, which was launched at Barrow some time ago.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trade.

THE coal strike is having a more and more serious effect on the various sections of the steel trade carried on in Sheffield, but the strangulation does not appear to be proceeding as quickly as might have been anticipated. While the many large furnaces devoted to the production of open-hearth steel are still idle, the manufacturing and engineering departments are managing to carry on to a considerable extent. They are all affected, of course, but to differing extents. Brown Bayleys, for instance, report that their wages bill for last week was about two-fifths of the average, that the heavier departments are not working, but they have enough fuel to make a small quantity of steel which they hope to turn out into finished goods. Edgar Allen and Co. say, "We have not closed any departments down, but some sections are not working full time." John Brown and Co. have coal for some departments but not for others; Hadfields, Ltd., are carrying on on a 50 per cent. basis; Vickers shut down their big coal-consuming departments a fortnight ago. Sheffield Steel Products, which uses gas as its principal motive power, and makes it itself, is running practically normally. Up to the present it has been able to get all the steel it requires. Some foreign coal is being used in the city, but the majority of firms are finding it too expensive. One of the departments which is able to carry on to a fair extent is that which makes railway axles, tires, and springs. The demand for files and various classes of engineering tools keeps up well, and manufacturers have a fair number of orders on hand.

Sir Robert Hadfield's Suggestion.

Sir Robert Hadfield, head of the great firm of Hadfields' Ltd., has made a suggestion for ending the present *impasse* in the coal trade. He says there is a growing feeling among the leading industrialists of the country that if the miners, the owners, and the Government refuse to make a move to end the stoppage, then some outside persons, possessing the necessary influence and authority, should be consulted with a view to their taking a hand. "If the stoppage lasts much longer," he said in an interview, "we shall have to close down in Sheffield altogether, and it is going seriously to affect our earnings at the end of the financial year. My idea is that some of our able and tried men in the industrial world might be selected from some of our foremost federations, such as the Iron and Steel Institute, the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Institution of Naval Architects, together with the sane leaders on the trade union side not connected with the coal industries, who would endeavour to find a peace formula. They would at any rate in their findings have public opinion behind them, and be fully representative of the employers and employed, who are being made to suffer through no fault of their own."

Electric Engines for India.

A contract of much importance, announced during the past week, has been secured by the Metropolitan-Vickers Electrical Company, and is for 41 electric locomotives for the Great Indian Peninsula Railway. The total value of the order exceeds £600,000. The locomotives will each weigh 115 tons, and will be rated at 2600 horse-power. The contract provides for regenerative braking, to enable heavy trains to be handled on the hilly sections of the line, where gradients of one in 40 and one in 38 are encountered regularly. Work will be provided for both the Sheffield and the Trafford Park factories of the firm. This is the second large order of the kind Metropolitan-Vickers have booked recently, the first being for no fewer than 95 electric locomotives for the South African railways.

A Shipping Order.

Cammell, Laird and Co., Ltd., have also booked an excellent order. It is for the construction of three boats for the conveyance of fruit, for Messrs. Elders nad Fyffes. These vessels will complete an equipment of twelve built by Messrs. Cammell, and will bring the Elder and Fyffe fleet up to the number of 33. One of the new boats is to be 300ft. long, 44ft. broad, and 25ft. deep, and the other two will be of larger size, having a length of 400ft., a breadth of 50ft., and a depth of 33ft. One of them is to be delivered in October and the other two in the spring. The keel for one of the vessels is already laid. The value of the contract is approximately £500,000.

A Foundry Concentration.

The Brightside Foundry and Engineering Company, Ltd., Sheffield, has decided, for reasons of convenience and economy, to close its Wicker Works, Sheffield, and henceforth to carry on its business at its Newhall-road, Attercliffe, and Ecclesfield Works. It states that the closing of the Wicker Works will enable it to offer considerable extra facilities for the production of all its manufactures at Newhall-road and Ecclesfield, where large extensions and improvements are being carried out. One of the reasons influencing the firm is that of rating. The rates in Ecclesfield, which is only just outside Sheffield, are lower than those in the city itself. The firm's head office will in future be at its Attercliffe establishment.

Chesterfield Tube Developments.

At the annual meeting of the Chesterfield Tube Company, Ltd., last week, Mr. W. A. Woodeson, the chairman, made some interesting remarks on experiments with new alloy steels which the company has carried out. The results, he said, were very encouraging. A large portion of last year was devoted to experimental work, and at the beginning of this year, while experiments were still going on, it received some substantial orders, owing to its being prepared for the demand for certain engineering products, such as tubes for special purposes made from these latest special alloy steels, which it correctly anticipated would become a largely increasing demand. The company has made several additions, improvements and modifications, and has largely increased its capacity for certain important work. A number of the old furnaces, which were becoming more or less out of date, have been replaced with modern and economical furnaces.

A Derbyshire Coal Find.

A successful result of coal boring operations is reported from Newhall, near Burton-on-Trent, which promises to be of much benefit to the South Derbyshire mining industry. The operations have been in progress for some months at the old Matts' Yard Pit, owned by Messrs. J. and N. Nadin and Co. It was believed that a rich seam existed at a lower level, and a number of coal owners in the district agreed to share the expense of boring, which has been heavy. It is now reported that the work has resulted in the striking of a seam of coal, 6ft. thick, at a depth of 200ft. below the Kilburn. The new seam is said to bear close resemblance to the well-known Barnsley bed.

NORTH OF ENGLAND.

(From our own Correspondent.)

Coal Trade Proceeds and Costs.

THE uneconomic state of the coal-mining industry in Northumberland and Durham is reflected in a striking manner in the ascertainments of proceeds and costs for the three months preceding the strike, which would in other circumstances have determined wages in the present month of June. In both cases the yield was far below the minimum level of wages, and provides irrefutable evidence that the collieries could not possibly go on without alteration in that level or a revision of the working hours, now that the subvention has disappeared. The accountants figures for February, March and April show that in Durham County the wages would have been 31.90 per cent. on basis rates, the lowest yet reached. The subsidy, which ended on April 30th, would, if it had been continued, have made it up to 110 per cent., so that the difference for which the Government would have been responsible would have been 78.10 per cent. The reduction on what would have been paid in May was 1.55 per cent. In December, 1924, the percentage on basis wages in Durham was 92.12 per cent., and it has fallen steadily ever since, until now, as already stated, the figures are 31.90 per cent. Northumberland is in a much more difficult position than Durham, because when the strike is over no one can say how long that county will be in recovering its lost steam coal export trade. If the ascertainment for February, March and April had regulated wages this month, the miners in Northumberland would have been entitled to 28.41 per cent. on the basis. The minimum level in Northumberland before the strike was 100 per cent. on the basis, and thus the State subsidy would have had to make up 71.59 per cent.

Non-union Pits Restart.

Though there is no evidence yet of any general break away on the part of members of the Durham and Northumberland Miners' Associations, it has become apparent during the last few days that non-union miners, who stopped work in sympathy with their union fellows, now desire to return to the pits. At two small non-union collieries in Northumberland a number of men have resumed, and coal is being brought to bank. In the case of the Barmoor Colliery, owned by the Hepscott Coal Company, half of the hewers have come to terms with the management and are now at work. The pit has a normal output of about 70 tons a day for the land sale trade, and some of the coal won goes direct to the large institutions on Tyneside. A small colliery at Stannington, which, like Barmoor, stopped work in sympathy with the other men, has resumed operations with a number of employees, and others are anxious to return, but are somewhat afraid because of their close proximity to other collieries employing union labour. One colliery at Healycote, near Brinkburn, and another at Woodburn have never ceased to draw coal. The total number of men employed at these collieries will be in the neighbourhood of 300. The owners are not affiliated to the Northumberland Owners' Association.

Cleveland Iron Trade.

The Cleveland pig iron trade is gradually approaching complete stagnation, and unless there is a speedy settlement of the coal dispute, the two furnaces which remain in operation will have to be blown out. Business is rapidly coming to a standstill simply because there is scarcely any more iron to sell. Such stocks as makers hold have been disposed of, and only small odd lots of iron can be picked up. Most of the principal works

have no No. 1 or No. 3 foundry iron left, but there seems to be a little No. 4 foundry and low-phosphorus iron for disposal, and when consumers are not particular as to quality, their requirements can be met. But the exhaustion of all these supplies is in sight, and any who have iron to sell can almost dictate their own terms. On the whole, there has been no disposition to exploit the situation, but naturally prices rise as the scarcity becomes more acute, and there has been a 1s. rise since last week. No. 1 Cleveland foundry iron is 79s., No. 3 G.M.B. 76s., No. 4 foundry 75s., and No. 4 forge 74s.

Hematite Pig Iron.

Hematite supplies are still available, and the existence of big stocks prior to the coal stoppage has proved a blessing in disguise, providing as it did a useful reservoir for the maintenance of supplies to consumers. It has also tended to stabilise the market, and whereas foundry iron has advanced 6s. per ton, hematite is only 2s. 6d. per ton more than the figure ruling seven weeks ago, mixed numbers still being available at 78s. 6d. and No. 1 at 79s. to 80s. per ton.

Iron-making Materials.

Best Rubio ore is nominally 21s. 6d. per ton c.i.f., but it is said that there is not a boat stemmed for the Tees, and the prospects of new business are entirely contingent on a settlement of the coal trouble. Business in coke is also at a complete standstill.

Manufactured Iron and Steel.

Most branches of the manufactured iron and steel trade are now seriously incommoded for lack of material, but the works being idle, producers are helpless, and can only claim the protection of the strike clause in regard to the fulfilment of contracts. Two shipyards on the Tees have been closed because of the lack of ship-building material. There is plenty of business on offer, if makers could meet it. Prices are unchanged.

The Coal Trade.

With the outlook in the coalfields giving no brighter sign of the appearance of a settlement, business in the Northern coal trade continues totally idle, and all inquiries still have to be turned down. In the meantime, all consumers on the Continent, in addition to works in all parts of the world, are steadily buying from competing countries. Germany, Poland and America are particularly benefiting from the stoppage, and are getting much higher prices for their surplus production than the values ruling in April last. Buyers abroad appear to have given up any idea of a resumption of business shipment from this side for a month or two, and are universally covering their requirements for July to September, and show no anxiety as to a continuance of the British stoppage.

SCOTLAND.

(From our own Correspondent.)

Acute Depression.

THE situation in Scotland, and more particularly in the West of Scotland, becomes more acute, and the failure of the negotiations between the owners and miners has therefore caused great disappointment. Steel, iron, and shipbuilding productions have all been seriously interfered with, and the losses already sustained must be enormous. The number of suspended employees becomes greater as time goes on, each week adding to the already huge total of unemployed workers, apart from the miners. Under present conditions activities in all industries must inevitably cease within a very short time now.

Continental Coal.

Cargoes of continental coal are now being discharged at Glasgow. This fuel will be used mainly for the bunkering of outward-bound Glasgow steamers. Other cargoes are on the way. Consignments are also due at Leith or Grangemouth for the London and North-Eastern Railway Company. A cargo of fuel originally intended for the River Plate, but delayed at Cardiff owing to the general strike, has been sent to Glasgow, also for the London and North-Eastern Railway Company.

Steel and Iron.

All the large steel works, with one exception, are idle. Steel sheet makers have plenty of orders on hand at present, and the only immediate worry is the fuel supply. The bar iron works are comparatively busy. Makers have fair commitments, both in iron and steel, and may not be able to clear their books before their coal supplies give out. Steel bars and sections are reported to be firmer in price. The output of pig iron is now extremely meagre, and some brands are in very short supply while others are almost unobtainable.

Iron Trade and Fuel Costs.

The manufacturers of bar iron and steel sheets held a meeting in Glasgow a few days ago at which the following resolution was passed:—"That this meeting of manufacturers engaged in the production of bar iron and steel sheets, and largely interested as consumers of coal, while regrettting the present dispute in the coal trade and realising the difficulties of dealing therewith, views with considerable alarm any proposals for a settlement which would result in an increase in the price of coal beyond an economic level. Such proposals, if carried into effect, would jeopardise the maintenance of all industries like their own, which have been faced for a number of years with the necessity of reducing costs of production as a condition of survival."

Oil for Fuel.

The Glasgow Corporation Tramways Department has adopted oil for generating purposes at the Pinkston Power Station in order to conserve the ample supply of coal on hand. Oil fuel has also been brought into service in connection with the subway railway.

Coal.

The demand for domestic fuel has been very moderate owing to warm weather, and supplies generally are ample.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Stoppage.

REPORTS have been current that by the end of this week important developments might be expected in the coal situation, which may lead to an early termination of the stoppage of work in the industry, but such optimism is not shared in this district. On the contrary, the outlook is regarded very pessimistically. It is held to be certain that there will be no resumption of work this month, and many who are interested in the trade entertain very little hope of operations being recommenced during July. Whenever a settlement is arrived at and the men get back to work, coalowners and exporters will, it is generally recognised, have a very hard fight to regain the markets in which they had their strongest hold. It is appalling to see the quantities of coal from America, Germany, and even Russia, which are being taken by consumers who came to this country formerly for their requirements. Foreign consumers are now having the chance of a lifetime really to find out what are the merits of fuel substitutes for Welsh coals, and their experience may be such as to warrant many of them continuing to take foreign coals, considering the uncertainty which so often exists in regard to the delivery of the British commodity. Whatever may be the eventual terms of settlement of the present dispute in the coal industry of this country, the one important factor which must not be lost sight of is that the costs of production must be brought down, as there is only one way of regaining the markets abroad, and that is to be able to offer buyers coals at a price which is tempting to them. The price will always be the controlling factor.

Effects of Stoppage.

Shipments of German and American coals, more especially the latter, to South America and European destinations, continue on an ever-increasing scale. In the space of a single week tonnage was taken up for loading at American ports amounting to over a quarter of a million tons, of which more than half was intended for the United Kingdom. The inquiry for American and German coals has been more active during the past week than it has been since the stoppage occurred, which rather tends to confirm the view that no immediate settlement of the dispute is expected. One cargo of American coal arrived at Bristol last week, while, excepting Milford Haven, the first cargo of foreign coal to arrive at a Welsh port has been discharging at Barry this week. This is a cargo of German coal, brought by the ss. Albr. W. Selmer, and is about 3300 tons. These coals are for a local industrial undertaking. Another smaller cargo is due at Penarth. Of course, the trade at South Wales ports is only a shadow of the normal, and will continue to be so until there is an end of our troubles and bunker coals can be obtained as easily as before the stoppage. There was no importation last week of either pitwood or iron ore, but in view of recent charters the quantity of timber from the Baltic to arrive at Welsh ports should be on a comparatively fair scale. Recently, however, grain arrivals have been active, while consignments of petroleum have increased considerably. The tin-plate and steel and iron undertakings are being disastrously affected. In the Swansea district the tin-plate works are feeling the position acutely as the finishing departments alone are kept going. The end of this week will practically see the complete termination of work at most undertakings.

Supplies of Coal and Patent Fuel.

There has been some relaxation in the regulations regarding supplies of coal and patent fuel. The latter commodity can now be obtained in unlimited quantity, as several of the patent fuel works are operating regularly. One or two of them have arranged substantial contracts for the delivery of supplies during the next few weeks to home consumers. The price to industrial consumers and for domestic purposes is 32s. 6d. and for bunker purposes 33s. 6d. A number of shipowners are taking patent fuel for bunkers, thus enabling them to get their boats away to continental ports, while it is possible for owners to obtain supplies of large coal for bunker purposes, provided they produce a homeward charter showing that they are sending the steamer away for the purpose of bringing back to this country a cargo of coal. A number of coal cargoes which have been held up since the stoppage commenced have also been released for home ports conditional upon the consumers being approved by the authorities, and subject to no claims being made against the Government for detention. The disposal of these cargoes has, of course, entailed a good deal of negotiation, as exclusive of the compensation to the shipowners for detention in dock for about six weeks, there are the claims of the original foreign buyers. Intending buyers have therefore to meet extra costs amounting to about 15s. to £1 per ton, and bear the cost of discharging the coal and its transport to the destination at which it is required in this country. Prices quoted have consequently run from about 35s. to 40s. per ton, c.i.f. any United Kingdom ports, for cargoes of large coal.

Docks Traffic.

The Great Western Railway Company's returns of trade for South Wales show that for the four weeks ended May 16th total imports and exports came to 1,896,280 tons, which was 914,445 tons less than for the four preceding weeks ended April 18th. Imports declined 77,381 tons and export decreased by 837,064 tons.

Export Business.

Operations for export are at a standstill; in fact, correspondence with clients abroad has almost ceased, as it is generally recognised that nothing can be done in the way of business until the coal dispute is settled, and there is a resumption of work. The fact that so many foreign consumers have had to look elsewhere for their requirements makes it impossible for them to say what they may be able to take from this district when coals are again available. The only definite inquiry which has been received is one from the French Railways for 10,000 to 20,000 tons of patent fuel for delivery during the latter half of this year. The same inquiry has also gone to French, German and Belgian manufacturers of patent fuel, and in view of the uncertainty as to what may be the position in this country it is almost certain that this business will go abroad.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Amalgamation Rumour Denied.

A REPORT which originated at Swansea to the effect that a scheme had been arranged for the amalgamation of Baldwins, Ltd., and Richard Thomas and Co., Ltd., the two largest iron and steel and tin-plate undertakings in South Wales, has been officially denied. It is stated, in fact, that the matter has never been discussed.

Proposed By-product Works.

It is stated that when the present coal troubles terminate Baldwins, Ltd., contemplates developing its mineral properties and proposes the erection of large by-product works in the neighbourhood of Kenfig Hill.

CONTRACTS.

CAMMELL LAIRD AND CO., Ltd., of Birkenhead, have received an order from the Isle of Man Steam Packet Company for a first-class passenger steamer for the Isle of Man service. The vessel will have geared turbines and a speed of 22 knots. The same firm has also received an order from Alfred Holt and Co. for an oil separating lighter.

INTERNATIONAL COMBUSTION, Ltd., of Africa House, Kingsway, informs us that its associated company in France has received an order from the Compagnie Parisienne de Distribution d'Electricité for the new Central Station at Issy-les-Moulineaux, Paris, for the installation of "Lopulco" pulverised fuel equipment to operate three boilers each having 19,400 square feet heating surface.

FOAMITE FIREFOAM, Ltd., of 24/26, Maddox-street, Regent-street, London, W. 1, has received an order from the Anglo-Persian Company, Ltd., for a Foamite installation for the protection of the jetties at Queen's Dock, Swansea.

CATALOGUES.

DAVID BROWN AND SONS (Huddersfield), Ltd., Lockwood, Huddersfield.—Treatise entitled "Worm Gear," incorporating all types of worm gearing for general engineering purposes, including a section dealing with worm reduction gearing.

MARRYAT AND SCOTT, Ltd., 28, Hatton Garden, London, W.C.—A beautifully illustrated catalogue describing some of the lifts installed by the company and the various types of lifts made for hotels, hospitals, warehouses and industrial buildings.

COOPERS HILL WAR MEMORIAL PRIZE.—The triennial award of the Coopers Hill War Memorial Prize, which fell to the Council of the Institution of Electrical Engineers last year, is still at its disposal, no papers having been submitted. The Council has selected the following seven subjects and members of the Institution are invited to submit for consideration not later than October 31st a paper on any one of them:—(*a*) "The Use of Electricity in Public Works;" (*b*) "Hydro-electric Power in Rural Districts;" (*c*) "Electrification of Railways;" (*d*) "Electricity in Agriculture;" (*e*) "Electric Railways in the Empire Overseas;" (*f*) "Hydro-electric Resources in the Empire Overseas;" (*g*) "The Line and Wireless Communications of India." Only corporate members of the Institution who were under thirty years of age on January 1st, 1926, are eligible for the prize, which consists of:—(*a*) A bronze medal; (*b*) a parchment certificate of award; and (*c*) a money prize of the value of about £25.

THE BRITISH ACETYLENE AND WELDING ASSOCIATION.—On Tuesday, June 15th, at the Hotal Victoria, Northumberland-avenue, London, Mr. Alexander Jackson was entertained to luncheon by the Council and Members of the British Acetylene and Welding Association. A presentation was made to him, as a mark of personal esteem and appreciation of his valuable and encouraging service to the Association, and the industry over many years. Mr. Jackson was president of the Association on two occasions, and he was vice-president for some half dozen terms. He further served on the Council since 1915, while he undertook the secretarial work of the Association for long periods. The presentation took the form of a book entitled "The Ruined Abbeys of Britain"—suitably inscribed—and six etchings. At the annual general meeting of the Association, which was held later, it was announced that Mr. Walter Yates was elected president for the year 1926–27, and Mr. Jackson was again elected vice-president.

THE SOCIETY OF GLASS TECHNOLOGISTS.—Some seventy members of the Society of Glass Technology visited the Osram Glass Works of the General Electric Company, Ltd., at Wembley, on June 2nd. The party inspected, first of all, the various processes employed in manufacturing the glass bulbs, tubing and apparatus used in making Osram lamps, Osram valves, and testing equipment used in the research departments for control purposes. An extended tour of the research laboratories followed, the party being split up into sections under guides, who described the various methods and apparatus associated with the various investigations being made. Luncheon was then taken and it was followed by speeches by the president, Mr. Walter Butterworth, Colonel Halse, and Mr. Paterson. Subsequently there was an adjournment to the library, where papers on glass technology were read by Mr. J. W. Ryde, of the G.E.C. research laboratory staff, on "Opal Glass;" by Mr. Bryson, on "Electrical Conductivity of Glass at High Temperature;" and by Dr. Turner, on "The Influence of Moisture on the Rate of Melting and on the Properties of Soda-lime Glasses."

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/- to 21/-
(1) Spanish	18/- to 21/-
(1) N. African	18/- to 21/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 6	—
No. 1 Foundry	4 0 0 to 4 2 6	
No. 3 Foundry	3 17 6 to 4 0 0	
N.E. COAST—		
Hematite Mixed Nos.	3 18 6	3 18 6
No. 1	3 19 0	3 19 0
Cleveland—		
No. 1	4 0 0	4 0 0
Silicious Iron	4 0 0	4 0 0
No. 3 G.M.B.	3 17 0	3 17 6
No. 4 Foundry	3 16 0	3 16 6
No. 4 Forge	3 15 6	3 16 0
Mottled	3 14 6	3 15 0
White	3 14 6	3 15 0
MIDLANDS—		
(5) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 0	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 3 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (a); 4 10 0 (b); 4 15 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	9 15 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¾in. and up	7 12 6	7 0 0
Sections	7 2 6	6 5 0
Steel Sheets, under 3/16in. to ¼in.	9 0 0 to 9 5 0	
Sheets (Gal. Cor. 24 B.G.)	—	£16 0 0 to £17 5s.

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 12 6	—
Angles	7 2 6	—
Boiler Plates	11 10 0	—
Joists	7 2 6	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 10 10 0†	
MANCHESTER—		
Bars (Round)	8 0 0 to 8 5 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	7 17 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 2 6	
Billets and Sheet Bars	6 2 6 to 6 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 10 0 to 15 15 0	
Angles	7 2 6 to 7 7 6	
Joists	7 2 6 to 7 7 6	
Tees	8 2 6 to 8 7 6	
Bridge and Tank Plates	7 17 6 to 8 2 6	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	21/- to 22/6
Block Tin (cash)	268 15 0
,, (three months)	268 12 6
Copper (cash)	57 10 0
,, (three months)	58 7 6
Spanish Lead (cash)	30 16 3
,, (three months)	31 0 0
Spelter (cash)	34 1 3
,, (three months)	34 0 0
MANCHESTER—	
Copper, Best Selected Ingots	63 17 6
,, Electrolytic	66 2 6
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	32 17 6
,, Foreign	32 0 0
Spelter	34 7 6

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/9d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/-
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0	scale 5/- per unit
,, ,, 75 p.c.	£20 10 0	scale 6/- per unit
,, Vanadium	14/6 per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND.

(*Prices nominal.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/9
,, ,, Ell	16/6
,, ,, Splint	16/6 to 17/-
,, ,, Trebles	15/9
,, ,, Doubles	14/- to 14/6
,, ,, Singles	13/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	16/9
,, ,, Jewel	17/- to 17/6
,, ,, Trebles	17/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/9
Screened Navigation	21/-
Trebles	14/- to 15/-
Doubles	14/-
Singles	13/- to 13/6
LOTHIANS	
(f.o.b. Leith)—Best Steam	14/- to 14/3
Secondary Steam	13/6
Trebles	14/6 to 14/9
Doubles	13/6
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	23/-
Household	40/- to 48/-
Coke	*No quotation.*
NORTHUMBERLAND—	
Best Steams	16/-
Second Steams	14/6 to 15/-
Steam Smalls	8/- to 8/6
Unscreened	13/- to 13/6
Household	20/- to 22/-
DURHAM—	
Best Gas	18/6 to 19/-
Second	15/- to 15/6
Household	20/- to 22/-
Foundry Coke	18/- to 20/-

SHEFFIELD	Inland.	
Best Hand-picked Branch	31/- to 34/-	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	26/- to 28/-	—
,, ,, House	24/- to 25/-	—
,, ,, Large Nuts	17/- to 20/-	—
,, ,, Small	12/6 to 14/-	—
Yorkshire Hards	17/- to 19/6	—
Derbyshire Hards	16/- to 19/-	—
Rough Slacks	10/- to 12/6	—
Nutty Slacks	7/6 to 9/-	—
Smalls	3/6 to 6/-	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	16/- to 17/-

(9) SOUTH WALES.

(*All prices nominal.*)

CARDIFF—	
Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary ,, ,,	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary ,,	16/- to 17/-
Washed Nuts	19/- to 20/-
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	18/- to 18/6
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 21/-
,, ,, Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	22/- to 24/-
Pitwood (ex ship)	26/6 to 27/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	39/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Restrictions.

WHEN there appeared to be a reasonable hope that the franc would come back to a level at which it could be safely stabilised, the outlook was distinctly favourable, and there was a feeling of buoyancy that had not been experienced for a very long time. Immediately, however, it was seen that the improvement was due to a spasmodic effort to inspire confidence, and that various measures of a more or less doubtful utility were proposed, the franc dropped again, and the disappointment was all the keener because the reaction was unexpected. One of the measures to be discussed is a restriction of imports and exports, on the plea that if France refrains from purchasing abroad her finances will necessarily improve and that, if exports of essential products are prohibited, there will be more for home consumption, and there will be no reason for an inflation of prices. This policy is by no means meeting with general approval, for it is evident that if the country does not purchase raw material abroad there will be less employment and fewer manufactured goods will be available for export. Besides, the mere fact of prohibiting imports would immediately inflate prices on the home market. On reflection, the Government has evidently found it necessary to modify its first proposal, and it is now hoped so to frame the measure as to avoid any risk of reprisals from other countries. For the moment, the situation is undoubtedly serious for foreign firms doing business with France, but until the proposal takes a concrete form, it is impossible to say to what extent they will be affected. Future action may also depend upon the negotiations which it is hoped to carry out with Belgium and Italy, whereby the three countries with depreciated currencies may adopt common action for the defence of their interests, particularly in the way of procuring raw material. It is obvious that such material must be purchased abroad if the textile and other industries are to be kept going at all. Meanwhile, all these indefinite proposals are having the effect of demoralising trade and industry, and prices all round are steadily advancing.

The Rhine Canal.

Every effort is being made to push forward the preliminary negotiations for the construction of the lateral canal in Alsace, which is an alternative scheme to the canalising of the Rhine favoured by German and Swiss engineers; but as France is empowered by the Treaty of Versailles to construct the canal, she is taking full advantage of her privilege, more particularly with the idea of supplying Alsace and the north-eastern departments with electrical energy from the power stations at each of the eight locks on the canal. The first and most important of these stations is at Kembs, and a Bill is to be introduced shortly into the Chamber of Deputies for granting a concession to the Société des Forces Motrices du Haut-Rhin, which will probably be entrusted with the task of carrying out the entire scheme. The cost of constructing the first section of the canal, with the locks and power station, is stated to be about 186 million francs, nearly one half of which will be devoted to the section of the canal from the Rhine to Kembs and of the overflow canal from Kembs back to the river, while the other half will be divided fairly equally between the locks and navigation works and the equipment of the station. Works will also have to be carried out in Switzerland, particularly the reconstruction of the sewage system in Basle, which would otherwise be flooded by the raising of the river level. In addition, the Rhine barrage will cost about 65 million francs, and that will be in charge of the State, but it is probable that the construction of the dam will also be entrusted to the Société des Forces Motrices du Haut-Rhin, and that the cost will be defrayed by a tax on power users.

Paris Sewage.

A commission from the Paris Municipal Council has visited the various sewage farms and stations around the city with a view of seeing what can be done to remedy a very serious situation, brought about by the fact that nearly all the communes above and below Paris are discharging their sewage and used water into the Seine and Marne. In the department of the Seine, excluding Paris, only about one-tenth of the houses send their sewage into sewers. About 250,000 cubic metres of sewage and used water are discharged daily into the Seine. The various experiments for treating sewage have cost a great deal of money, and have not given satisfactory results. The sewage farm at Créteil is nearly abandoned, and will be entirely suppressed in two years' time. At Mont-Marly the bacterial plant can only deal with a very small quantity of sewage from the communes. So far as Paris is concerned, Clichy receives 800,000 cubic metres a day out of a total of 950,000 cubic metres. All the collectors go to Clichy, with the exception of one which delivers directly into the Seine at St. Denis. The used water and sewage first pass through basins where the heavy matter is deposited and then over grids which collect the lighter matter. The liquid is then pumped to Gennevilliers and Colombes for final treatment. From there it traverses the Seine and is carried by a main, 13½ miles long, to be employed for irrigation at Achères, Méry Pierrelaye and Carrières-Treil. Achères takes a considerable quantity of Paris sewage, and it is now found necessary to extend the farm to the other side of the Seine at La Frette, where it is proposed to bring all the sewage and used water from the communes by two huge collectors, while a collector will also be constructed from Clichy to La Frette. The Clichy plant is to be transformed.

Continuous Brakes.

In a conference before the Société des Ingénieurs Civils, M. Drosne, of Messrs. Schneider and Cie, dealt with the problem of continuous brakes for goods trains, and, after stating that the existing systems were more or less a compromise, declared that an entirely new form of brake would shortly be introduced which would completely fulfil all the required conditions.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

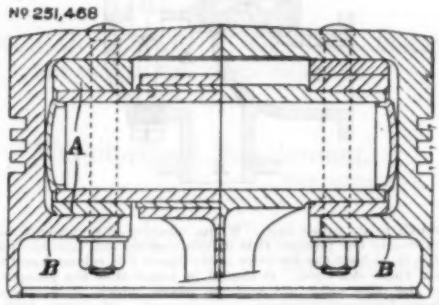
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

251,468. June 19th, 1925.—PISTONS, E. L.-S. Engines, Ltd., 29, Spring-gardens, Whitehall, London, S.W. 1, and E. Lanzerotti-Spina, 67, Prevend-gardens, Stamford Brook, London, W. 6.

The inventors suggest that the weight of the piston may be reduced by shortening its length, and that it is preferable to

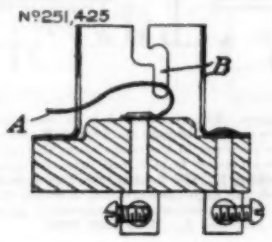


arrange the piston rings opposite the centre of pressure of the gudgeon pin. The rings would, of course, prevent the introduction of the gudgeon pin in the normal manner, so it is arranged for assembly on the connecting-rod, together with bearing pads A A. It is then slipped into the piston and turned through a right angle, when the pads engage with the lugs B B and can be bolted in place.—*May 6th*, 1926.

SWITCHGEAR.

251,425. April 20th, 1925.—TESTING SERIES CIRCUITS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2; H. C. Wheat, 31, Hillmorton-road, Rugby, and F. M. Cocksedge, 25, Lanford-road, Rugby.

This is a simple device for testing whether electric lamps connected in series are themselves defective, when a failure

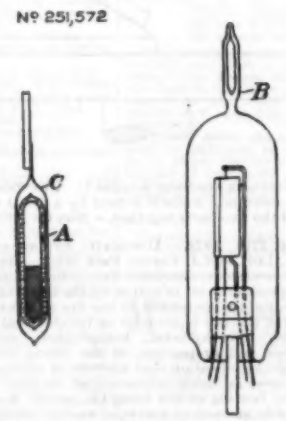


occurs, or whether the fault is in some other part of the circuit. The concentric type of fitting is necessary, and the centre contact is extended as shown at A, so that if the lamp is pushed down below the normal position, with the lugs in the slots B, the extension is pressed on to the base and short-circuits the filament.—*May 6th*, 1926.

ELECTRICAL APPLIANCES.

251,572. December 31st, 1924.—VACUUM TUBES, E. Y. Robinson, 15, Wimslow-road, Withington, Manchester, and the Metropolitan-Vickers Electrical Company, Ltd., 4, Central-buildings, Westminster.

This invention is concerned with the introduction of the vapour of cæsium into vacuum electric tubes, with the object of increas-

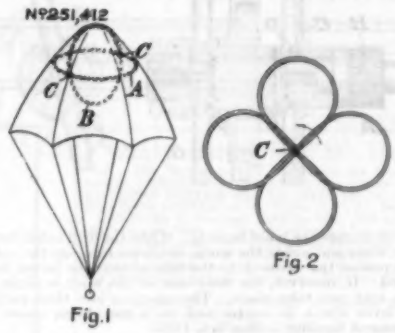


ing the electron emission of the cathode. In the past it has been considered necessary to use a special glass for the tube in such cases, as the cæsium vapour reacts with ordinary glass at the temperature necessary for its distillation. The inventors provide the necessary cæsium in a small glass capsule A, and insert it in an extension B of the main tube. The capsule is surrounded by a nickel tube C, which is heated by high-frequency induction. The cæsium vaporises, pierces the glass capsule, and escapes into the main tube, without the latter being heated appreciably. The extension B is then sealed off.—*April 30th*, 1926.

AERONAUTICS.

251,412. March 28th, 1925.—PARACHUTES, H. E. S. Holt, The Grange, Farnborough, Hants.

The object of this invention is to ensure the rapid opening of the pilot of a main parachute. In the head of the pilot there are

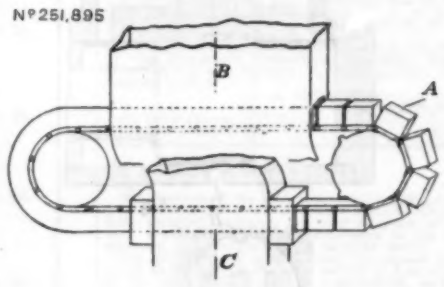


two rings of spring wire A and B, which are fixed together at C C. The ring A is stitched to the fabric all round, while B is stitched only round the upper half of its circumference. When free the rings extend the pilot as shown in Fig. 1, but they may be collapsed, as shown in Fig. 2, for packing.—*May 6th*, 1926.

FURNACES.

251,895. December 15th, 1925.—AIR PREHEATERS, E. F. H. Mercier, 57, Rue Pierre Charron, Paris.

In this specification the inventor enlarges upon the objections to other types of apparatus for preheating the air supply to boiler furnaces, and then goes on to describe his own ideas. He literally uses a conveyor for transferring the heat of the flue gases

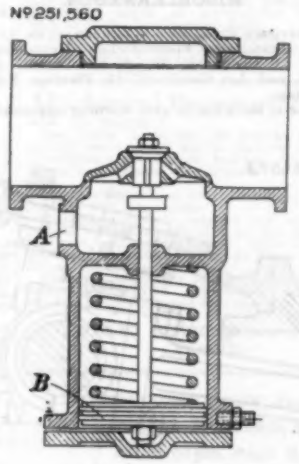


to the incoming air. The conveyor A takes the form of a series of bottomless boxes which are filled with loosely piled rods. One side of it travels through the flue B, while the other side returns through the air duct C. It is claimed that the heat transference by the rods is more effective than is the case with other preheaters, while distortion does not affect the efficiency of the rods.—*May 13th*, 1926.

LOCOMOTIVES.

251,560. December 24th, 1925.—CLEANING FEED-WATER HEATERS, Knorr-Bremse Aktiengesellschaft, Neue Bahnhofstrasse 9–17, Lichtenberg, Berlin, O. 112, Germany, and P. Juliusburger, Lyck-Allee 36, Charlottenburg, Berlin.

The inventors propose to clean out any deposit which may



accumulate in the feed-water heater of a locomotive by occasionally "scavenging" it with the water itself. For this purpose they provide the valve shown in the drawing, somewhere in the length of the feed pipe. The outlet A allows the scavenging water to escape, to atmosphere, rapidly, and the valve is opened by admitting steam below the piston B.—*May 6th*, 1926.

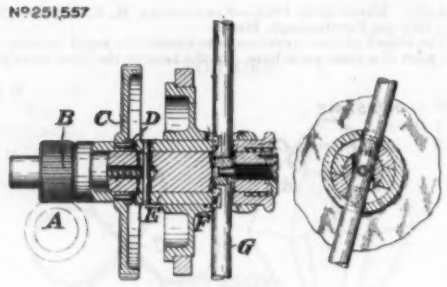
MACHINE TOOLS AND SHOP APPLIANCES.

251,557. December 12th, 1925.—FEED MECHANISM FOR DRILLING MACHINES, Sir A. Herbert, Dunley Manor, near Whitchurch, Hants, P. V. Vernon, Keresley Manor, near Coventry, and C. Wilson.

This feed gear is of the type in which the drill can be fed up to

its work rapidly by hand, and so soon as the drill encounters the resistance of its work, a power-driven feed automatically comes into operation. The drilling spindle A is fed forward by the pinion B. C is a power-driven feed wheel free to rotate on the pinion shaft, and provided with clutch teeth at D. The sleeve E has corresponding teeth, and also at the opposite end notches

N°251,557



F, which engage the hand lever G. When the drill is fed forward by the lever and meets the work, the lever rides up the notches F and pushes the sleeve E to the left, so that the power feed is engaged. If, however, the resistance of the work is slight, this action may not take place. The operator can then rock the hand lever about its centre and push the clutch sleeve into engagement forcibly.—*May 6th*, 1926.

251,855. October 8th, 1925.—DISC VALVES FOR ROCK DRILLS, The Ingersoll-Rand Company, 15, Exchange-place, Jersey City, U.S.A.

In this rock drill, which is of the hammer type, the compressed air is distributed to the two ends of the working cylinder by means of a "flutter" valve A. This valve, as is shown in the plan view, Fig. 2, is disc-shaped, and is held in place by two

N°251,855

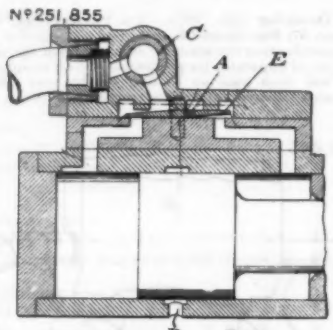


Fig 1.

Fig.2.

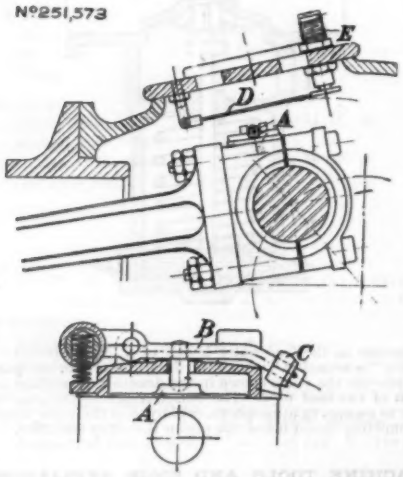
loosely fitting pegs B B. The air is supplied to the valve box through a normal throttle valve C, and exhaust takes place through the port D. As shown in the drawing, the piston is travelling to the left, urged forward by air passing over the edge E of the valve. When the piston uncovers the exhaust port, the pressure will fall below the edge E of the valve, and it will tilt over to admit air to the opposite end of the cylinder.—*May 13th*, 1926.

MISCELLANEOUS.

251,573. February 22nd, 1926.—TEMPERATURE ALARM APPARATUS, Naamloose Vennootschap Kromhout Motoren Fabriek D. Goedkoop, Jr., 2, Ketelstraat, Amsterdam, Holland, and Jan Goedkoop, 13, Plantage Franschelaan, Amsterdam.

This device is intended to give warning automatically of an

N°251,573

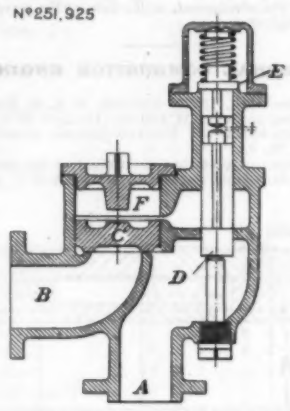


undue rise in the temperature of a bearing, such as that of a crank shaft. The illustrations of the specification are confusing, but it appears that a "capsule" A is affixed to the bearing and contains a liquid of which the boiling point is equal to the permissible working temperature. If that temperature is exceeded the capsule expands, and pushes out the lever B. The roller C then engages with the rod D, as the crank rotates, and actuates any convenient means of alarm through the plug E.—*May 6th*, 1926.

251,925. March 17th, 1926.—SAFETY VALVES, Société Anonyme des Etablissements Jules Cocard, 32 à 40, Rue de Valenciennes, Lille (Nord), France.

In this safety valve the connection with the boiler is shown at A and the escape branch at B. The main safety valve is marked C, and is normally kept on its seating by steam pressure leaking

N°251,925

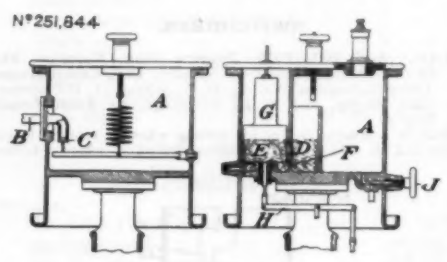


through to its upper face. When, however, the pressure rises abnormally the plunger D is driven upward and lifts the pilot valve E, so that the pressure in the space F is released and the main valve can open. It should be noted that the plunger D and the pilot valve are separate pieces, which, it is claimed, reduces frictional resistance to movement.—*May 13th*, 1926.

251,844. September 24th, 1925.—PRESSURE REGULATORS, Galloways, Ltd., Knott Mill Ironworks, Manchester, and H. Pilling, Glenderwyn, Manchester-road, Chorlton, Manchester.

This device is intended for maintaining within close limits the steam pressure in a range supplied from another working at a higher pressure. In the drawings the two views are elevations

N°251,844

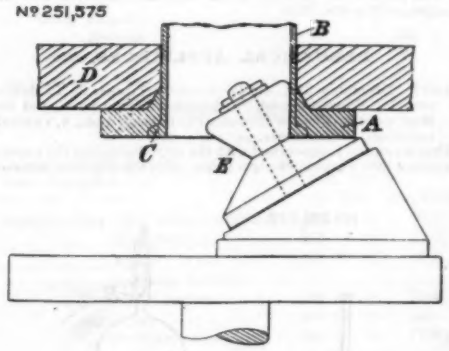


in different planes. The chamber A is in communication with the low-pressure system through the branch B and spring-loaded valve C. If the pressure in the range rises, the valve opens and mercury in the chamber D is forced into the compartment E through the opening F. The float G rises and actuates the steam control valve on the high-pressure side through the linkage H. The leak-off valve J prevents any excessive accumulation of pressure in the chamber A.—*May 13th*, 1926.

251,575. March 11th, 1926.—WELDING FLANGES ON TUBES, Foster Brothers, Ltd., and H. F. Foster, Leabrook Works, Wednesbury, Staffs.

By this process a flange A is welded on to a tube B by first

N°251,575



upsetting its end so as to form a collar C. The flange is correspondingly recessed and while it is held by a die D the roller E is used to weld the two parts together.—*May 6th*, 1926.

251,788. May 27th, 1925.—AUTOMATIC SPRINKLERS, Mather and Platt, Ltd., and J. Taylor, Park Works, Manchester.

This invention relates to automatic fire-extinguishing sprinklers in which the sprinkler is set in action by the bursting of a vessel containing a liquid that is heated by the fire to be extinguished. The claim is for the use of acetone or its chemical synonyms, dimethylketone, dimethylketal, ketopropane, methylacetyl, pyroacetic ether and propanone, as the filling liquid. It is explained in the specification that acetone in whichever way it has been prepared is highly compressible, so that when compressed, by the heating of the frangible vessel, it stores up a very considerable amount of potential energy, which is almost instantaneously expended when the vessel bursts. Further, the liquid has a very high thermal expansion, which compensates for the great compressibility previously referred to, so that the temperature of bursting of a frangible vessel filled with the liquid may be made as low as is required in practice, and, if desired, below the boiling point of the liquid. Acetone is equally effective whether the frangible vessel does or does not include air or other gas.—*May 13th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting at Ipswich

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council's Garage, Millfields-road, Lower Clapton, N.E. Metropolitan District meeting. 4.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District meeting at Spenborough. 10.30 a.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Golden Eagle and its Neighbours," by Mr. Seton Gordon. 9 p.m.

TO-DAY AND SATURDAY, JUNE 19TH.

FOUNDRY TRADES' EXHIBITION at the Royal Agricultural Hall, Islington, London, N. 1. 11 a.m. each day.

SATURDAY, JUNE 19TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District meeting at Kettering. 11 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Eastern District meeting at Stockton-on-Tees. 10.45 a.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. General meeting. 2.30 p.m.

MONDAY TO WEDNESDAY, JUNE 21ST TO 23RD.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer Meeting at Scarborough.

MONDAY TO SUNDAY, JUNE 21ST TO 27TH.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in Belgium. For programme, see page 588.

WEDNESDAY TO FRIDAY, JUNE 23RD TO 25TH.

NEWCOMEN SOCIETY.—Summer meeting at Norwich. For programme, see page 565.

WEDNESDAY TO SATURDAY, JUNE 23RD TO 26TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Annual general meeting and Conference at Bristol. For programme, see page 506.

THURSDAY, JUNE 24TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—The Science Museum, South Kensington, London, S.W. 7. Conversazione. 8.30 p.m.

FRIDAY, JUNE 25TH.

DIESEL ENGINE USERS' ASSOCIATION.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Some Deleterious Properties of Lubricating Oils," by Mr. J. E. Hackford.

MONDAY, JUNE 28TH.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—Finsbury Technical College, Leonard-street, London, E.C. 2. Silvanus Thompson Memorial Lecture, "The Rise of Atomic Physics," by Mr. C. A. Darling. 8 p.m.

WEDNESDAY TO FRIDAY, JUNE 30TH TO JULY 2ND.

BRITISH WATERWORKS ASSOCIATION.—Meeting at Bristol. For programme, see page 649.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. W. J. E. BINNIE, of Sir Alexander Binnie, Son and Deacon, has been elected chairman of the Committee of the Association of Consulting Engineers for the year 1926–1927.

THE *Indian Railway Gazette*, Calcutta, of the proprietor of which is Thorne's, Ltd., has, we understand, opened its own offices at 69, Fleet-street, London, E.C. 4, from which offices all European and American business will in future be conducted. Mr. Theo. H. Thorne will control the affairs of the *Gazette* from the London offices.

MR. H. J. TRIVESS SMITH, M. Inst. C.E., M.I. Mech. E., who has just resigned the post of Special Engineer of the Tansa Completion Works, Bombay, on the successful termination of that important undertaking, is about to start in private practice as a consulting engineer in water supply at The Manor, Southbourne, Emsworth, Hants.

ROBERT BROADBENT AND SON, Ltd., of Phœnix Ironworks, Stalybridge, inform us that at the Dunedin, New Zealand, Exhibition that closed April 30th, their stone crushing machinery, consisting of one of their jaw type stonebreakers and one set of their patented crushing rolls, both in operation, electrically driven, achieved the highest award, "First Award of Merit—Gold Medal."

LAUNCHES AND TRIAL TRIPS.

PHOBOS, motor tanker; built by the Netherland Shipbuilding Company; dimensions, 440ft. by 59ft. by 32ft. 9in.; 10,000 tons deadweight. Engines, double-acting, four-cycle, 3500 horse-power; constructed by Werkspoor, Amsterdam; launch, June 5th.

IDOMENEUS, motor vessel, built by Workman, Clark and Co., Ltd.; to the order of Alfred Holt and Co., of Liverpool; dimensions, 476ft. by 58ft. by 35ft. 3in. Engines, two sets of eight-cylinder, four-stroke Diesel; constructed by the builders; launch June 10th.